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DISEASES DUE TO PROTOZOAN PARASITES.

YAKIMOFF (W. L.) & Others. **Trypanosomiasis of Camels in Russian Turkestan.**—*Parasitology* 1918. Nov. Vol. 11. No. 1. pp. 35–80. With 3 plates comprising 20 figs., and 29 tables.

The existence of trypanosomiasis amongst the ruminants of Turkestan has been suspected for many years, but the first definite record is that of LÜHS (1906), who discovered *Trypanosoma theileri* in the blood of cattle in Transcaucasia. This was followed by the discovery of the same parasite in the Trans-Baikal region (DUDUKALOFF), the Don Province (STOLNIKOFF), and in the Pskov and Vitebsk Governments (Yakimoff and BEKENSKY). WRUBLEWSKI found this trypanosome in the blood of bison from the Bieloviejsky forests and later it was discovered by Yakimoff in Turkestan.

FEINSCHMIDT (1912) was the first to record the presence of trypanosomiasis amongst the camels of the Astrakhan Government and the following year Yakimoff and his collaborators (1913) confirmed this discovery. SCHUKEWITSCH (1914) also observed trypanosomes in the blood of camels from the Ural Region.

The proximity of Turkestan to Afghanistan and India, where surra occurs in camels, led the authors to suppose that camel trypanosomiasis would be most likely to occur in the southern latitudes of the country. It was ascertained that in the Tashkent District a camel disease, called by the natives "surah," occurred and was attributed by them to the animals feeding on a certain kind of plant. The blood of 502 camels in Tashkent and surrounding localities was thus examined, mostly during the months of July and August, and trypanosomes were found in 22 cases, giving a total percentage infection of 4·38. The percentage infection varied widely in different localities, being highest on the Afghanistan border. In addition, trypanosomiasis was discovered amongst the camels of Samarkand and Askhabad by inoculating blood into guinea-pigs, although trypanosomes were never actually seen in the camels themselves. Guinea-pigs were infected with the virus from four different localities, the blood of a large number of camels being utilised for inoculation in each case. These four strains were then submitted to an exhaustive examination in Petrograd.

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In fresh preparations the living parasite exhibited fairly active movements, slower than those of *T. brucei* but more active than those of *T. equiperdum* (Russian strain). In stained preparations the morphology of the parasites varied somewhat in different experimental animals. The parasite is said to approximate to the general type of the nagana and surra trypanosomes. Multiplication was by longitudinal fission.

The measurements of the Turkestan trypanosome in the camel were as follows :—total length 20·94 to 24·49μ, without flagellum 13·84 to 17·75μ, width 1·42 to 2·84μ, length of nucleus 2·13 to 3·55μ, length of free portion of flagellum 4·26 to 8·52μ. These correspond closely with those of the trypanosomes from the camel in the Ural and the Astrakhan regions. By passage through various experimental animals, both small and large, the Turkestan trypanosomes did not alter appreciably in size; the greatest divergence in length, 18·4μ and 28·75μ, occurred in the same animal, the pig. Even in the same animal, the horse, the average length was 21·97μ one day and 22·46μ the next. The measurements, however, differed somewhat from those recorded for the other pathogenic trypanosomes and even slightly from the geographically related *T. evansi* of India, but the measurements alone, it is stated, are insufficient to distinguish the two.

Blood containing trypanosomes drawn from a foal and preserved on ice was found to contain motile trypanosomes after four days but was non-infective after eight days. After seven days storage at 17° C. the blood also became non-infective.

Experiments were made to determine the effect of various sera upon the trypanosome. It was found that normal human serum had the most marked effect and in descending order that of the normal rabbit, horse, and bull; although bovine serum agglutinated the trypanosomes more rapidly than horse serum did, the time during which it retained this power was less. The action of the serum of animals infected with the trypanosome varied in different species. Whilst that of an infected calf acted more energetically than the serum of a normal animal the serum of an infected rabbit took longer to produce agglutination but maintained its action for a greater period than that of normal rabbits. The action of the sera of animals immunised against various other diseases was also tested.

The trypanosome was found to be transmissible experimentally to many species of mammals and also to some species of birds. The course of the disease was acute in mice, rats, and dogs; sub-acute in guinea-pigs, rabbits, and horses, and chronic in large cattle and sheep.

In the case of mice the trypanosomes appeared in the circulating blood a few days after inoculation but soon afterwards disappeared for a certain period. Later, as a rule, they reappeared but in certain cases the blood remained free from parasites. Nevertheless, the blood of these animals was proved to be infective by sub-inoculation and their spleens were hypertrophied. Death occurred six to nine days after intraperitoneal and eight days after subcutaneous inoculation. After a series of passages in mice, however, the virus became exalted so that the incubation period was reduced to one day and death occurred one to six days after inoculation.

The effect upon white rats was similar to that produced on white mice, but after exaltation the incubation period was reduced to three

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to four days and death occurred eight to ten days after infection. Grey rats were also easily infected.

In rabbits the trypanosomes appeared in the blood in from four to 13 days after inoculation and death occurred in from 13 to 18 days. The rabbits emaciated considerably, no oedema was observed, the blood became pale.

In the guinea-pig the trypanosomes appeared in the blood in three to 17 days, and death occurred 13 to 33 days after infection, the period depending on the method of infection, quantity of trypanosomes introduced, and the virulence of the organism. The trypanosomes were not always present in the blood of these animals. No external symptoms were observable.

Dogs were easily infected, trypanosomes appearing in the blood four days after intraperitoneal and five to eight days after subcutaneous inoculation. The organisms were moderately numerous in the blood at the time of death (after 35 days in one case), but during the course of an infection they showed a tendency to disappear from the blood from time to time. At the periods of maximum blood invasion the animals showed rises of temperature, dullness and inappetence. During the course of the disease one observed considerable emaciation, sudden presence of oedematous swellings, chiefly on the abdomen and about the eyelids, frequently keratitis and sometimes pareses and diarrhoea.

One ram infected subcutaneously showed in its blood 21 days afterwards small numbers of trypanosomes, which then disappeared and never re-appeared.

A young pig inoculated subcutaneously with infected blood showed trypanosomes in its blood on the 21st day after inoculation, on the 53rd to the 54th day, and on the 71st to the 72nd day. It died on the 73rd day in an emaciated condition.

Horses were easily infected. One foal inoculated subcutaneously showed a rise of temperature on the eighth day after inoculation and subsequently seven times before death, which occurred on the 82nd day. Trypanosomes were visible in the blood on the 19th day after infection but their presence was demonstrable by mouse inoculation as early as the eighth day. The parasites appeared in rather small numbers in the blood during seven perods, each lasting about four days. The symptoms observed were yellowish discolouration of the conjunctiva and lip, petechiae for a short time on the conjunctiva, purulent discharge from the eyes, and reddening of the eyelids. During the second half of the period of illness the foal showed weakness and for about a fortnight before death it was hardly able to stand. No oedemata were observed during the infection.

A young bull inoculated subcutaneously showed visible trypanosomes for the first time 18 days after infection but by inoculation of mice their presence was detectable on the 14th day. The parasites were visible for four days and then seemed to disappear entirely. However, a mouse inoculated 48 days after the infection had appeared became infected. Later, guinea-pigs inoculated after 97 and 105 days did not become infected. The animal thus recovered, but no immunity was conferred. The serum did not afford any protection against infection on mice. One hundred and forty three days after the first infection the bull was inoculated subcutaneously a second time with

a larger number of trypanosomes and in four days the parasites appeared in its blood but later they disappeared. No symptoms of disease were observed.

A goose inoculated intravenously with richly infected blood from a mouse succumbed 37 days afterwards and during the whole period trypanosomes were never observed in the blood. Nevertheless, the goose proved to be infected, for two mice inoculated—one after seven days (subcutaneously), and another after 21 days (intraperitoneally)—became infected.

A fowl, a duck, and a pigeon proved immune.

The blood changes were very carefully studied in the case of a foal inoculated subcutaneously with the trypanosomes, and which remained infected for 81 days. At the end of this period the red corpuscles had decreased by 28·85 per cent. of their original number. Beginning from the 10th day after infection there was noted an agglutination of the red corpuscles, from the 13th normoblasts, and from the 17th polychromatophilia. The percentage of haemoglobin, which amounted to 80 per cent. before infection, fell to 45 per cent. for some time during the later course of the disease. The colour index was ·7 on the eighth, ·9 on the 13th, ·8 on the 18th, but from the 36th day, when it was 1·1, it began to increase,—up to 1·8 for three days before death. There were four periods of leucocytosis: (1) initial, short, during four days (2–5 days), due to the spread of the infection in the organism, (2) also short, coinciding with the appearance of trypanosomes in the blood, (3) the longest, during 39 days (from the 28th to the 66th day), (4) a shorter period lasting 12 days (from the 70th to the day of death) in the course of which there were two falls and the curve in general was not so high as in the third period. The proportion of leucocytes to red corpuscles before infection was 1 : 840. Later in the first period of the disease it increased (1 : 1,240 on the 13th day), but as the infection advanced the ratio became less than the normal until it fell to 1 : 112 on the 79th day. This shrinkage was due to simultaneous oligocythaemia and leucocytosis. The distribution of the different forms of leucocytes during the infection was as follows:—1st period, primary nucleosis with a diminution of the percentage of lymphocytes; 2nd period, the longest, characterised by mononucleosis (chiefly by lymphocytosis) with an increase in the mast cells and a decrease in polynuclears, both neutrophile and eosinophile; 3rd period, secondary polynucleosis (greater than the primary) with a corresponding diminution in the percentage of lymphocytes.

A number of observations were also made on the so-called Arneth index in this foal. The changes observed were briefly as follows:—First period, on the first 2–3 days after infection there was a temporary decrease in binuclear polynuclears, the beginning of a rise of the trinuclears, and a slight rise of the tetra-, penta-, and hexanuclears. Second period, the longest, terminating with the death of the animal was characterised by the following: from the fifth day the percentage of the binuclears began to rise; the trinuclears continued to rise; the tetra-, penta-, and hexanuclears remained below the normal and the penta- and hexanuclears disappeared from the blood at times. The phenomenon known as the "shift to the left," termed anisocytosis by ARNETH, thus took place.

The alkalinity of the blood, estimated by ENGEL'S method, decreased from 0·58455 prior to infection to 0·25980 before death.

A similar careful study was made of the blood changes in a dog during infection with the camel trypanosome. This animal was inoculated with a large quantity of blood containing trypanosomes intraperitoneally and became infected after an incubation period of only four days. It succumbed on the 35th day. Trypanosomes appeared in the blood on the fifth day after infection and after this during three periods, viz., from the eighth to the 14th, 16th to 25th, and 29th to the 35th days.

From the beginning of infection to the first appearance of trypanosomes the blood picture was characterised by, primary leucocytosis, polynucleosis, decrease in the percentage of leucocytes, beginning of the " shift to the left " of the Arneth index, beginning of the decrease in the number of red blood corpuscles. Then followed a second period characterised by a tendency towards a decrease in the total number of white blood corpuscles, a tendency towards an increase in the percentage of lymphocytes and towards a decrease in neutrophiles, the Arneth index " shifted to the left," the number of red blood corpuscles fell. The third period, which lasted several days before and up to death, was characterised by secondary leucocytosis, polynucleosis, decrease in the percentage of lymphocytes and increase in neutrophiles, " shift to the left " of the Arneth index, large fall of the red blood corpuscles.

These phenomena corresponded with those observed by other authors in dogs infected with *T. brucei*, *T. equinum*, and *T. gambiense*.

In infected mice the same phenomena were observed as in the case of dogs infected with the trypanosomes, with the same three periods, viz., 1st period, from the moment of infection to the appearance of trypanosomes in the blood, characterised by primary leucocytosis; during the 2nd period leucopenia was observed; during the 3rd period, preceding death, there was a secondary leucocytosis, but smaller than the primary.

The pathological changes in the animals that had succumbed as the result of experimental infection were few. In mice and rats the spleen was greatly enlarged. In guinea-pigs there was no marked hypertrophy of the spleen while in rabbits it was but slightly enlarged. The infected foal showed no striking lesion except oedema of the subcutaneous connective tissue of the neck, breast, and around one joint, yellowish infiltration under the pleura in the anterior part of the chest, on the pericardium, transverse sulcus of the heart muscle and the intermaxillary space, slight exudation in the thoracic and peritoneal cavities, and emaciation. The young pig infected showed on post-mortem examination emaciation, appreciable enlargement of the lymphatic glands, presence of a small amount of exudate in the thoracic and peritoneal cavities and in the pericardial sac; the spleen was enlarged. The dead goose exhibited no changes.

Chemotherapy. The following products were tested:—(1) From the arsenic group: atoxyl, arsenosolvin, salvarsan, tartar emetic, and trixidin. (2) From the benzidine group: trypan-blue and dianil-blue (or trypanil).

Experiments were first carried out on mice so as to determine the maximum dose of the drug that could be tolerated; then on the

first day trypanosomes appeared in the blood of infected mice they were injected with a solution of the drug, in all cases intravenously except in the case of trixidin.

It was found that atoxyl was not a suitable preparation. In the case of tartar emetic the therapeutic co-efficient was not favourable $\left(\frac{\text{curative dose}}{\text{tolerated dose}} = \frac{1}{1{\cdot}37}\right)$; the action of the preparation on the organisms was very energetic, their disappearance was noted in one mouse. Trypan-blue and trypanil proved to be unsuitable trypanocides. Trixidin, a preparation consisting of a 30 per cent. oily emulsion of antimony trioxide, which was injected subcutaneously, proved to be a much more effective remedy. ·001 gramme per 20 grammes weight of the mouse was sufficient to cure it of trypanosomiasis while the maximum tolerated dose was 0·25 gramme.

"Curing by stages," or the introduction of repeated doses of the preparation at certain intervals of time, proved unsuccessful in the case of tartar emetic but cures were obtained after the use of atoxyl injected intravenously three days in succession. Combined treatment with tartar emetic or atoxyl, and trypan-blue or trypanil did not produce positive results, neither did combined treatment by stages produce any good results.

Preventive treatment by means of tartar emetic and trixidin gave unsatisfactory results. The experiments on chemotherapy are being continued.

The injection of normal human serum appeared to produce a considerable delay in the appearance of trypanosomes in the blood of an infected mouse but serum from a rabbit infected with trypanosomes, and anti-anthrax serum produced no effect.

DEGREEF (G.). **Symptômes nerveux et persistance des Trypanosomes dans le liquide céphalo-rachidien de mules atteintes de Nagana du au *Trypanosoma Brucei* var. *ugandae*.** [The Nervous Symptoms and Persistance of Trypanosomes in the Cerebro-spinal Fluid of Mules affected with Nagana due to *T. brucei* var. *ugandae*.]—*Bull. Soc. Path. Exot.*, 1919. Jan. 8. Vol. 12. No. 1. pp. 17–22.

The observations recorded by Degreef were made in the course of military operations undertaken by Belgian troops in the territory which was formerly German East Africa during the period April–December 1916. The contagious diseases which decimated military horses in this campaign were horse sickness, producing the loss of a whole lot of 100 mules imported from South Africa, glanders, and trypanosomiasis. The last-named disease affected about 20 per cent. of the units under the author's charge. This was not surprising in view of the fact that the troops had to traverse a region infested throughout with *Glossina morsitans* from Bieramulo up to Tabora. Some infections disclosed trypanosomes of the type *brucei* var. *ugandae* and others those belonging to the group *dimorphon-congolense*. The infections were frequently mixed in character. In the blood of mules infected with *T. brucei* short forms without free flagellum showing displacement of the nucleus towards the posterior extremity were not uncommon. These forms were probably identical with the parasite discovered by FISCHER (1913) near Lake Victoria, and by

Redford in the Northern Province of Uganda. This trypanosome proved pathogenic for the native grey rats, the parasites appearing in the blood three days after subcutaneous inoculation of 1 c.c. of mule blood rich in trypanosomes.

Various methods of treatment were adopted with a view more especially to maintaining the animals at work than in an attempt to cure them, for, even at Tabora, they were exposed to re-infections. Some of the animals under treatment had to be slaughtered owing to the appearance of glanders among them. The medicaments employed consisted of the following mixtures:—tartar emetic-orpiment, tartar emetic-atoxyl, or tartar emetic-orpiment-tryparosan. The affected animals received a series of four intravenous injections of 1 or 1·5 gramme of tartar emetic together with a series of four doses of 8 grammes each of orpiment *per os* or with four subcutaneous injections of 4 grammes atoxyl. One animal received besides the emetic-orpiment treatment two doses of 8 grammes of tryparosan. The treatment was resumed after each relapse. It was well tolerated and although it did not cure all the animals it prolonged their life and maintained their strength.

Out of 25 mules kept under observation, five which were not treated succumbed rapidly, three from nagana and two from trypanosomiasis due to organisms of the *dimorphon-congolense* type. Out of 20 animals treated seven were alive three months after the end of the treatment apparently cured, two remained under treatment and continued to suffer from relapses, five died from glanders and two had to be slaughtered on account of this disease, while four died in spite of the treatment.

Of these four animals three had received five series of four injections of tartar emetic-atoxyl, the fourth four series of injections of tartar emetic and three series of orpiment. These animals all suffered from *T. brucei* infection and before death exhibited symptoms of cerebro-spinal derangement. Microscopic examination of the blood made during a fortnight after the last treatment administered remained negative but the general condition of the animals did not improve. The appetite was poor, the gait stiff and painful, and the heads were carried low. The temperature reached from 39° to 40° C., the animals soon became affected with incoordination of movements of the limbs. In one case symptoms of very marked paresis of the hind quarters were manifested although this region remained sensitive; the animal retained to a large extent its strength in the other parts of its body whilst the hind limbs were dragged along the ground; marked inco-ordination of movements were seen when the animal was supported on its feet and forced to move. The animal finally fell prostrate and died after several hours. In another case very pronounced nervous hyper-sensitiveness was observed, lasting for three days accompanied by a temperature of 39·8° to 40·5° C.; this was followed by a period of depression and coma lasting four days with diminution or disappearance of reflex actions.

Post-mortem examination of three of the above four animals exhibiting nervous symptoms showed marked congestion of the meninges with some diffuse haemorrhagic infiltrations. A microscopic examination of the nervous tissue was not made. The cerebro-spinal fluid, which was much more abundant than normal and somewhat cloudy, showed

numerous trypanosomes. Inoculation of one c.c. of the liquid into a native rat set up an acute infection from which the animal died after a fortnight. Five c.c. of the same liquid injected subcutaneously into another mule set up hyper-acute trypanosomiasis from which the animal died in 14 days; this animal did not show any nervous symptom and on post-mortem examination the cerebro-spinal fluid was negative as to the presence of trypanosomes.

Nervous symptoms have been described by various authors in the case of equidae affected with a chronic form of nagana; but the above observations recorded by the author are of interest inasmuch as these symptoms were observed in mules which had been rid of trypanosomes from the blood following upon medicinal treatment, while parasites persisted in the cerebro-spinal fluid.

CURASSON (M. G.). **Sur le traitement des trypanosomiases animales au Soudan.** [Treatment of Animal Trypanosomiases in French Sudan.]—*Bull. Soc. Cent. Med. Vet.*, 1918. Nov. 9. *Rec. Med. Vet.*, 1918. Nov. 30. Vol. 94. No. 22. pp. 482–488.

In view of the results obtained in the treatment of human sleeping sickness by MARTIN (G.) and LEBOEUF and by THIROUX and D'ANFREVILLE DE LA SALLE the author tried the effect of picric acid combined with atoxyl or tartar emetic in the treatment of the various trypanosomiases of the horse, ox, and dromedary. Picric acid was utilised largely on account of the lack of other medicaments, but the results obtained after the use of this drug appeared to be sufficiently encouraging to merit their publication. These results were on the whole as good as those obtained after the use of other arsenical combinations—atoxyl-orpiment, tartar emetic-orpiment, or tartar emetic-atoxyl. The employment of picric acid in these cases in all probability contributed largely towards the result obtained inasmuch as tartar emetic or atoxyl alone rarely gave such consistent results. The advantage of using various drugs alternately in the treatment of trypanosomiasis is well known.

(1) *Atoxyl-picric acid.* The method of treatment was as follows: Four injections of atoxyl were given every five days and in the interval between these injections the animals were administered four daily doses of picric acid. After a week's rest this treatment was repeated. The dose of atoxyl was 4 grammes in the case of a horse and 5 grammes for the ox and dromedary, given subcutaneously in 10 per cent. solution sterilised by repeated boiling. The picric acid was given in the form of balls made with gum arabic and meal, each containing 50 centigrammes of extract of opium. The doses of picric acid were gradually increased from 2 grammes up to 10 grammes in the case of the horse and up to 12 grammes in the case of the ox and dromedary. Four horses affected with *souma*, three cattle with *baleri*, and six dromedaries with *m'bori* were treated in this way.

The horses affected with *souma* all presented the chronic form of the disease which is the only form seen in the north-western region of French Sudan, whilst in the region situated south of the River Senegal the acute form predominates, especially as one nears

the Guinea River. The symptoms were distinct—chronic emaciation in spite of good appetite, occasionally slight oedematous swellings affecting the limbs and exceptionally the sheath and the scrotum, petechiae on and yellowish discolouration of the conjunctiva, intermittent high temperature (40° to 41° C.) with marked dullness, loss of appetite, more distinct congestion of the visible mucous membranes, and diarrhoea. During these crises it was possible to make a diagnosis by microscopic examination or experimental inoculation. The trypanosomes were morphologically identical with *T. cazalboui* and were numerous in the blood during the crises. At other times a positive diagnosis was made by inoculating 20 c.c. of blood into a sheep intraperitoneally. On the other hand the pig and monkey appeared to be immune. The disappearance or at least a great diminution in the number of parasites in the blood followed the second injection of atoxyl. One animal only had a relapse after the first series of doses during the period of rest. A week after the end of the treatment the animals were tested by inoculation into the sheep and the goat, with negative results. During the following three months no relapses were observed. This treatment was also employed successfully in the case of five other infected horses.

Baleri exists more frequently in the ox and zebu and crosses between these two species than has hitherto been described. The author encountered the condition only among these animals in the north-western regions of French Sudan, but it exists in an enzootic form in the Guidimaka and Diafounou districts. Enlargement of the spleen and numerous interstitial blood extravasations in the bladder are almost constantly seen post-mortem. Glossina, which are generally considered to be the transmitting agents, do not occur in this region. On the other hand Stomoxys are common around the swampy areas. The animals observed all presented the chronic form of the disease and the three animals under treatment had been ill for at least six months and showed extreme emaciation and dullness, rough coat, and unsteady gait. The visible mucous membranes were rather paler than normal but contained no petechiae. The appetite was preserved and sometimes a slight diarrhoea was seen. On blood examination no parasites are usually seen in this disease (they were found once only in ten animals examined). Inoculation of blood into rats was positive in three out of seven cases, the rats dying between the 14th and 22nd day. Their blood contained large numbers of trypanosomes identical with *T. dimorphon* or *pecaudi*. The three cattle thus shown to be infected were treated as above. A week after the end of the treatment the animals were tested by rat inoculation with negative results. No relapses subsequently occurred.

M'bori, which is clinically identical with surra, is a very common affection of dromedaries in the northern part of French Sudan and especially around swampy districts where Stomoxys are the only biting flies seen. The acute form is rare; the chronic form, which is of more frequent occurrence, has a relatively short course, many animals dying after three months of the disease. The animals treated showed the following symptoms:—rapid emaciation, dullness and marked weakness, irregular appetite, frequently occurring febrile crises accompanied by inappetence and diarrhoea. Six dromedaries in very poor condition were chosen for treatment from a number of

animals that were infected in the course of a considerable outbreak. Blood examination was positive in four out of the six, and rats inoculated with blood succumbed in five out of the six cases between the 12th and the 18th day. The treatment was carried out in the same way as for the cattle, with no untoward incident. A week after the second series of doses had been given the blood proved sterile by rat inoculation and no relapses were seen after two months observation.

(2) *Tartar emetic-picric acid.* Five horses affected with *souma* and four dromedaries affected with *m'bori* were submitted to this treatment. The tartar emetic was finely powdered, held in suspension in a mixture of oil (9 parts) and camphor (1 part), sterilised by repeated heating, and injected intramuscularly. The dose was 1 gramme in the case of the horse and 1·5 gramme in the case of the dromedary administered at exactly the same intervals as in the case of the atoxyl in the preceding treatment, with picric acid given also daily as before during the intervals. No untoward incidents were observed except the formation of several abscesses in the case of one horse, which were opened and then healed quickly. A slight firm swelling formed at the seats of the injections for a few days and when opened were found to contain a brownish liquid within a thin-walled fibrous sac.

The five horses affected with *souma* were in very poor condition and were submitted to treatment after a diagnosis had been made during a febrile crisis. In one of the animals a relapse occurred during the interval of eight days rest; this animal showed a further crisis 12 days after the end of the treatment. It was the only case of failure. After treatment subsequently with atoxyl it was cured. The four other horses tested eight days after the last injection of tartar emetic by inoculation into the sheep were found to contain no trypanosomes. While under observation for a period of 2½ months they regained condition and were capable of being put to work three weeks after the last injection.

Three of the dromedaries treated were infected naturally with *m'bori* while the fourth was infected experimentally. The blood showed parasites even between the febrile crises identical morphologically with *T. evansi*, and capable of killing rats between the 8th and 11th day after inoculation. No abscesses were formed but firm swellings occurred at the seats of inoculation which persisted for some time. Three months after the end of the treatment the dromedaries had recovered condition, were able to work, and had shown no relapses.

The administration of picric acid produced in the case of horses a slight diarrhoea in spite of the use of opium, but the cattle and dromedaries were not affected in this way. The urine was coloured yellow two days after the commencement of the treatment, due to the excretion of the picric acid apparently and not to bile pigments. Yellowish discolouration of the mucous membranes and the sclerotic of the eye appeared on the 4th or 5th day and took a long time to disappear. No excessive amount of albumin was found in the urine.

The atoxyl-picric acid treatment is said to have furnished better results and to be more easily applicable than the tartar emetic-picric acid combination but it has the disadvantage of being more expensive.

PRICOLO (A.) & FERRARO (G.). **Circa il Tripanosoma del camello della Colonia Eritrea.** [The Trypanosomiasis of the Camel in the Colony of Eritrea.]—*Clinica Vet.*, 1918. Nov. Nos. 20–21. pp. 522–524.

In this short note the authors state that the account given by DOMIZIO [see this *Bulletin*, Vol. 6, No. 4. p. 221] of the trypanosome of Eritrean camels confirms their own observations recorded in 1912, and that the trypanosome is undoubtedly *Trypanosoma evansi*, identical with that already known to occur in other parts of Northern Africa, viz., Egypt, Algeria, Morocco, Sudan and Somaliland. They base their assertions on the fact that the trypanosome shows no appreciable difference from *T. evansi* as regards morphology, pathogenicity for various species of animals, transmission, which does not take place by means of Glossina, and the clinical symptoms produced in the affected animals; the opportunities for infection arising owing to the camel traversing long distances across the continent of Africa would be great. In view of these facts the authors attach comparatively small importance to the results of so-called cross-immunity experiments. It is affirmed that the infection does not occur along the Mediterranean coast of Tunisia and Tripoli; the sporadic cases encountered occur in animals that have travelled from some distant country.

REYNOLDS (F. H.) & SCHOENING (H. W.). **Separation of Trypanosomes from Blood in Antigen Preparation.**—*Jl. Agric. Res.* 1918. p. 573. [Extracted in *Jl. Trop Med. & Hyg.* 1919. p. 20.].

"By the plan recommended by the authors the blood of inoculated rats is collected in citrated saline and then strained through muslin and centrifuged for twenty minutes at 2,000 revolutions. The clear liquid is drawn off and centrifuged again to recover any trypanosomes present. The first deposit, consisting of corpuscles and trypanosomes, is agitated with distilled water for twenty minutes until the red cells are completely laked. The liquid is then centrifuged for half an hour when the trypanosomes are all collected at the bottom of the tube. The liquid is poured off and the deposit is washed with saline and centrifuged. The saline is rejected and a preserving fluid consisting of glycerine and saline is added to the trypanosomes, and the mixture is stirred well to produce a uniform emulsion. This is stored on ice.

"Comparative tests were made of the antigen prepared by the new method and one prepared by the present method. It was found that the use of distilled water to lake the corpuscles had had no detrimental effect on the trypanosomes with regard to their antigenic value, and that their anti-complementary action was diminished."

HORST (M. D.). **The Influence of Anorganic Antimony-Compounds on Trypanosomes in the Animal-Body.**—*Folia Microbiologica.* 1918. Nov. Vol. 5. No. 2. pp. 126–140. With 1 text fig., 1 table & 1 chart.

In this paper the author describes a few experiments in which the effect of antimony compounds was tested upon two strains of trypanosomes, viz., one of nagana and one of dourine. The dourine strain in the course of transmissions through mice in the laboratory had undergone considerable increase in virulence so that it was

doubted whether it was really the original strain, and thus it is now called the "D" strain. The experiments were performed on guinea-pigs and rabbits.

The preparation first used was tartar emetic in 1 per cent. strength dissolved in sterile physiological salt solution. The animals were treated with big doses, and with small doses, administered after long and short intervals, but the results in all cases were the same—the animals died after a longer or shorter period of illness. It was, however, possible to prolong life for months and thus a method was evolved by means of which the strains of trypanosomes could be kept alive more economically than formerly. The animals are given just enough tartar emetic to keep them alive, the trypanosomes subsequently returning regularly into the peripheral circulation. The dose for a guinea-pig is about ·5 to ·75 gramme per 100 grammes body weight, and for rats about the same. Sometimes 10 minutes after the injection the parasites disappear from the blood and no doubt the majority of them are destroyed.

The other preparation tried was antimony trioxide Sb_2O_3. The powder was held in suspension in a mixture consisting of syrupus simplex (Swiss pharmacopoeia) 100, powdered gum arabic 7·5. This usually contained 150 mgm. of Sb_2O_3 per c.c. and after having been carefully mixed in a mortar it was sterilised at 120° C. for 15 minutes. A complete cure was obtained in the case of two rabbits out of nine after the injection of a single dose of this suspension intravenously. There appears to be some risk of death owing to embolism following upon injections of this substance. The preparation corresponds with that placed on the market and known as trixidine.

MACHT (D. I.) & WEINER (J.). **On the Action of Opium Alkaloids on *Trypanosoma brucei*.**—*Proc. Soc. Exper. Biol. & Med.* 1918. No. 20. Vol. 26. No. 2. pp. 26–27.

In the course of an investigation upon the toxic action of the opium alkaloids on Paramoecia Macht and FISHER (1917) found that the group of alkaloids of which papaverin is the principal representative killed these organisms very quickly, whereas the group of which morphine is the principal member is comparatively non-toxic. Experiments were then undertaken in order to find out whether the opium alkaloids were also toxic for other forms of protozoa and especially for trypanosomes. *T. brucei* was selected for this work.

Experiments in vitro revealed that the papaverin group of alkaloids was very toxic. Papaverin itself in dilutions of 1–10,000 markedly inhibited the movements of the organisms in a few minutes and killed them completely within 30 minutes. The morphine group, however, was also found to be deleterous to the trypanosomes, but to a much smaller degree.

Experiments were then made on infected rats to ascertain whether papaverin could be employed in curing the infection with trypanosomes *in vivo*. It was found that small doses of this alkaloid had no effect in shortening the course of the disease, and that small doses of the benzyl constituents of this alkaloid were likewise inefficient.

ARZT (L.) & LOUCKA (Vinzenz). **Ueber Pferdepiroplasmose in Südost-Albanien.** [Equine Piroplasmosis in South-East Albania.]—*Wien. Klin. Woch.*, 1918. Oct. 3. Vol. 31. No. 40. pp. 1086–1087.

MARKOFF (1914) described the occurrence of equine piroplasmosis in Bulgaria as the result of observations made during the first Balkan war (1912–1913) and also in 1914. The affected areas appeared to comprise the coasts of the Sea of Marmora and the Gulf of Saros, the Plateau of Kuru ur Dekir Daag and areas lying southwards from Keschan and Malgara, along the valley of the Ergene River up to the coast of the White Sea in Macedonia, and also in Old Bulgaria. In 1916 this author recorded the presence of the disease also in western Bulgaria.

Piroplasmosis was first observed among German army horses in Southern Macedonia in May 1916 and a study of the affection was undertaken by KNUTH (P.). Austrian horses employed in this territory also became affected in the summer of 1916 and in 1917 but later the disease apparently disappeared. In the spring and summer of 1918 a considerable number of Austrian horses were utilised in South-east Albania along the Skumbi River and in Langaica Tal and around the northern end of Lake Ochrida. The first cases of piroplasmosis occurred in May 1918 among these horses, which were quartered in very mountainous country covered with a thick shrubby vegetation. The largest number of cases occurred in June and the history of the cases showed that infection must have been contracted after the arrival of the horses in this region.

The symptoms shown by the affected animals were the presence of petechiae on the conjunctival and vaginal mucous membranes—but not on the nasal or buccal membranes—sometimes accompanied by icterus which in such cases could then be observed on all the visible mucous membranes. The disease was frequently ushered in by an attack of colic especially in horses in good condition. The temperature rose up to over 42·4° C., pulse up to 108 per minute, and acute dyspnoea apparently indicating pulmonary oedema was also observed. Horses lost condition in spite of a good appetite, which was only lost when the temperature rose to over 40° C. The animals showed uncertain gait and finally paresis and paraplegia of the hind quarters. In some cases the urine was dark red up to chocolate colour in tint whilst in other cases it remained amber-coloured, without the presence of mucin. Treatment with neosalvarsan and corrosive sublimate produced no good effect. The mortality amounted to about 23 per cent.

A microscopical examination of the blood was made from a number of cases. The authors found great difficulty in determining whether the infesting species was *Nuttallia equi* or *Babesia caballi*. From the accounts given in the literature the authors state that it is hard to differentiate between these two parasites. Intra-corpuscular elements in the form of a Maltese cross could only be found on a few days during the course of the infection and more especially when the parasites were most numerous in the peripheral blood. The presence of these elements would appear to indicate that the species was *Nuttallia equi*. The form most commonly encountered was the small ring-shaped form, usually with two small chromatin masses. Two such separate

bodies were occasionally seen in a single red corpuscle. The cytoplasm was, however, frequently very irregular in outline, sometimes in the form of delicate strands reminding one of the so-called quinine forms of the human malarial parasite, sometimes much larger and pear-shaped with a chromatin mass at the pointed end. The chromatinic mass in the ring- and pear-shaped forms was often not included within the cytoplasm. "Maltese cross forms with four distinct chromatinic masses at the four ends of the two cross-pieces were also seen." These forms, which would characterise the disease as a nuttalliasis, were absent in many cases, and in these cases paired, elongated, pear-shaped structures disposed so as to meet at an angle with the chromatin masses in each touching one another were present in very small numbers. The pear-shaped forms were also seen in rare instances to lay in close apposition to each other along their whole length. On account of the sparsity of the parasites in many of the animals examined and their multiplicity in form it would be quite impossible to state which of the recognised species could be held accountable for the disease. Further details concerning these points and also with regard to the transmission of the disease are promised in a later communication.

VRIJBURG (A.). **Babesiose en Babesiaparasieten in Nederland.** [Babesiasis and Babesia Parasites in Holland.]—Reprint from *Tijds. v. Diergeneesk.*, 1918. Oct. 1 & 15. Vol. 45. Nos. 19 & 20. 33 pp. With 4 plates & 4 charts.

This article gives a comprehensive account dealing with the pathology of redwater in cattle in various parts of the world and includes but little that is new information or represents original work. Some observations are recorded dealing with the life cycle of *Ixodes ricinus* which is apparently the transmitting agent of redwater of cattle in Holland.

The adult female tick was found capable of laying eggs when kept at just a few degrees above 0° C., but at this temperature only a few larvae emerged after eight months. After storage for six months at this temperature and subsequent exposure to a changeable winter temperature the eggs were killed. Engorged larvae were found to remain alive for more than ten months. At room temperature the fully engorged females laid eggs after 18 days and larvae emerged 46 days later. Larvae emerged from eggs kept at outside temperatures after 59 days.

The parasite which is the cause of cattle redwater in Holland appears to be, according to the author, *Babesia bovis*. From a review of the literature he maintains that this parasite is identical with those described by LIGNIERES in Argentina as *Piroplasma argentina*, by MCFADYEAN & STOCKMAN (1911) as *P.* (*Babesia*) *divergens*, and also with some of the forms described by DSCHUNKOWSKY & LUHS in Caucasia under the name *Piroplasma annulatum*. The author agrees with NUTTALL that the name *B. divergens* should be abolished, and that the name *B. bigemina* should be retained for the Texas fever parasite and *B. bovis* for the European parasite and those forms indistinguishable from it. The non-identity of the *bigemina* and

bovis types appears to be firmly established as the result of observations on cross immunity, natural transmission, and morphology. The author gives a plate representing semi-diagramatically the very varying appearances presented by the parasite described as *B. bovis* and another plate, after NUTTALL and GRAHAM SMITH, is given for comparison containing a number of figures illustrating the much larger parasite *B. bigemina*.

At the end of his article the author details a few experiments in which cattle were inoculated with virulent blood or infected by means of ticks. The results do not add anything material to the already existing knowledge with regard to the mode and course of piroplasm infection in cattle.

SOHNS (J. C. F.). *Microbabesia divergens* in Nederlandsch-Indië. [*Microbabesia divergens* in the Dutch East Indies.]—*Nederl.-Ind. Blad. v. Dergeneesk. e. Dierent.*, 1918. Vol. 30. No. 5. pp. 385–459. With 3 plates.

In this article a comprehensive study is recorded of redwater infection in cattle imported from Australia to Java for slaughter purposes. Numerous references to the literature on the subject are quoted for purposes of comparing the affection and the parasite discovered with those described by various authors in different parts of the world. The list closes with a list of 65 references. The author's plates are reproduced so as to convey an idea as to the morphology of the parasite studied by him.

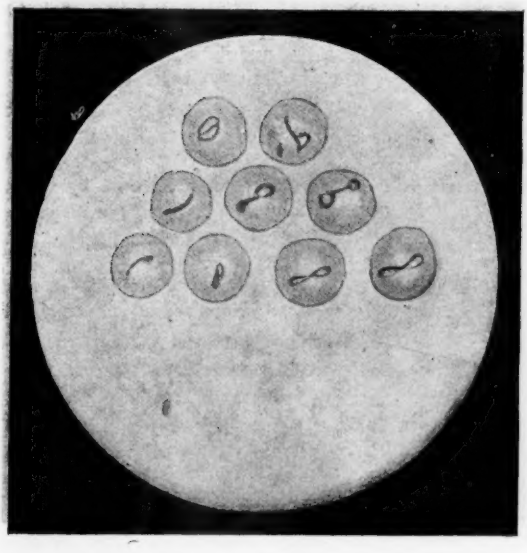

FIG. 1.

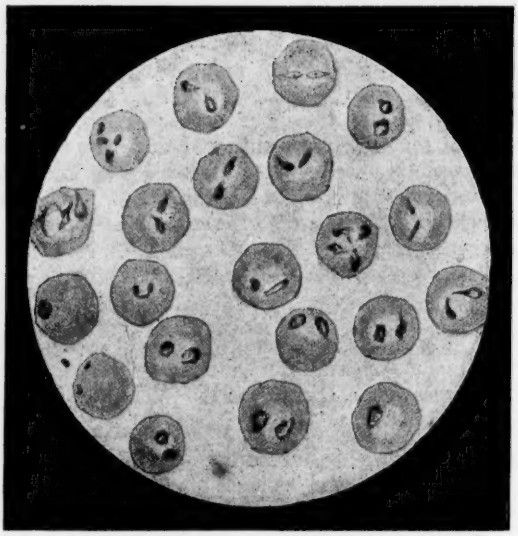

FIG. 2.

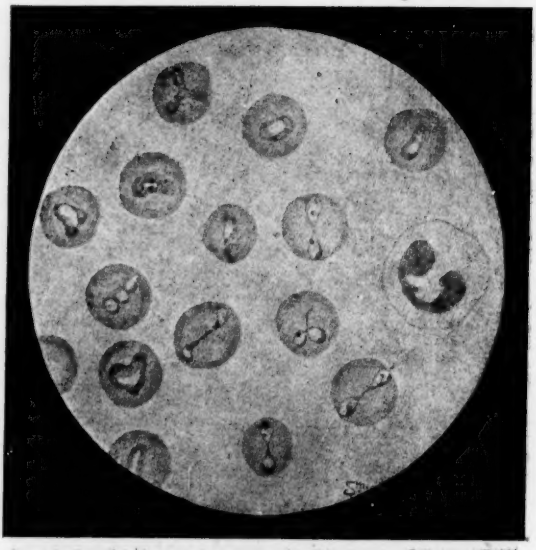

FIG. 3.

The author's own summary, which is given in English, is as follows :

"1. The small babesiae in cattle, occurring in the Balkans, Finland, Germany, Holland, England and France morphologically and pathogenically are the same, and so are probably the more or less incompletely described small parasites found in Italy, Norway, the Argentine Republic, perhaps also that from North-Africa and Egypt.

"2. In 1917 I discovered in slaughtering cattle, recently brought from Australia to Java, a small babesia that cannot be but identical with the above mentioned.

"3. The parasite is distinctly smaller than *Babesia bigemina*, and occurs in the peripherical blood mostly in slender forms, but in hitherto unknown periods. It also appears in the spleen and liver, but most numerous in the kidneys, in which inner organs it assumes a shorter and plumper, often an almost round shape, probably indicating a resting stadium. These rounded forms also prevail in bloodsmears taken a certain time after death.

"4. The twin forms in the peripherical blood often diverge, even so much as to lying in one longitudinal axle, an indeed very characteristic phenomenon.

"5. This small babesia seems to take the Giemsa and Leishman stains very irregularly.

"6. For this parasite, already known by three names, *Babesia bovis*, *B. divergens* and *Piroplasma argentinum*, I propose the name *Microbabesia divergens*, giving better than others the characteristic peculiarities, i.e., the smallness and the divergence.

"7. The symptoms in the beginning are often indistinct nor do they present any marked difference from that of Texas-fever ; redwater however is not constant, but icterus occurs more frequently, a symptom that Smith & Kilborne did not mention in their description of Texas fever.

"8. At the post-mortem most writers did see no more difference than in the consistency and colour of the bile, in Texas fever being thick and green, in divergentiosis like apricot-jam.

"The haemorrhagic and anaemic infarcts in the kidneys, in Java stated in almost every case, were not or indistinctly mentioned by other authors.

"9. From the literature the rupture of the spleen (splenorrhexis) first mentioned by Nicolle & Adil Bey in 1899 (in the neighbourhood of Constantinople), appears to be a characteristic feature of microbabesiosis.

"10. This disease causes less severe losses than Texas fever.

"11. Inoculation with microbabesia causes but a mild affection, followed by immunity.

"12. According to Macfadyean & Stockman Texas fever and divergentiosis do not give mutual immunity, but Ligniéres states that the microbabesia gives an absolute immunity against *Babesia bigemina*, while the latter leaves but an incomplete immunity against the microbabesia. If this is proved true we have no longer need of inoculating with *B. bigemina*, as the much less pathogenic microbabesia will suffice.

"13. The intermitting host in Java is *Boophilus australis*.

"14. According to Von Hellens and Nosotti chinine bisulfate is useful but only in the early stage. Trypanblue seems to be almost ineffective. Perhaps ichthargan is better. Removing the diseased cattle to the stable is likely to meet success even in hopeless cases.

"15. Java obviously got the disease from Australia.

"16. Dipping of cattle so before shipping as after arrival is necessary ; so is the cleaning (preferably with steam) of cattle-steamers and wagons after use."

Lentz (W.). **Hühnerspirillose in Serbien.** [Spirillosis of Fowls in Serbia.]—*Cent. f. Bakt.*, 1. Abt. Orig. 1918. No. 11. Vol. 82. No. 3–4. pp. 303–304. With 1 text fig.

In February 1918 the author observed in Serbia a few cases of fowl spirillosis caused by organisms identical with *Spirochaeta*

gallinarum, first described by MARCHOUX and SALIMBENI in Rio de Janeiro in 1903 and later discovered in many other parts of the world. The disease commenced with loss of appetite and high fever, then weakness and dullness, foetid diarrhoea and more or less intense lameness. The comb next appeared paler and shortly before death was of a deep bluish red colour. Five out of seven affected birds recovered, one died and the other was killed. Post-mortem examination showed swelling and softening of the spleen, fatty degeneration of the liver and a fibrinous exudate on the epicardium. Smears from the blood of the fowl that died showed fairly numerous spirochaetes, three per microscopic field, while in the blood of the other bird that was killed just before natural death there were found a sparing number of spirochaetes and innumerable coccus-like bodies apparently resulting from the destruction of the spirochaetes during the febrile crisis. In this outbreak it is noteworthy that the disease did not take place during the warmer period of the year but in the depth of winter. The winter was, however, broken by a period of about a fortnight of warm weather during which time the fowls wandered on to some damp pastures and apparently contracted the infection through the agency of ticks (*Argas miniatus*). It is also of interest that contrary to what has been stated in former records the spirochaetes did not disappear entirely from the blood shortly before death but were observable in blood examined six hours after natural death.

DISEASES DUE TO METAZOAN PARASITES.

JACK (Rupert W.). **Tsetse Fly in Southern Rhodesia, 1918. (A Popular Account.)**—*Rhodesia Agric. Jl.*, 1918. Oct. Vol. 15. No. 5. pp. 406–415. With 2 plates comprising 7 figs. and 1 map (in No. 6).

In this article the author gives an account of the species of tsetse flies, their habits and distribution in Southern Rhodesia. Interest in this question has lately become very acute in certain parts of the territory and this article is written in order to dissipate certain false ideas from the minds of stockowners on the subject. The only species of tsetse fly recorded in the territory is *Glossina morsitans* Westw. Along a portion of the Melsetter-Portuguese border, where the Busi River and its tributaries take their rise in Rhodesian territory, two other species occur, viz., *G. brevipalpis* Newst. and *G. pallidipes* Aust. No specimens of these flies have as yet been captured on the Rhodesian side of the border but the recent losses from fly disease in this area seem to indicate that a few specimens do cross at certain seasons of the year.

The various areas known to be infested at present in Southern Rhodesia are as follows:—

1. Sebungwe Belt, occupying the major portion of the western half of the Sebungwe district.

2. Umniati Belt, lying astride the Umniati River, partly in the Hartley and partly in the Sebungwe districts.

3. Lomagundi-Zambesi Valley Belt, lying north of the escarpment in the Lomagundi district, and extending eastwards in the valley into the Darwin district.

4. Tchetchenini Belt, in the neighbourhood of Tchetchenini Mountain, in the Lomagundi district.

5. Suri-Suri Belt, in the neighbourhood of the Suri-Suri River between Hartley and Gatooma, in the Hartley district; believed now to be extinct.

6. Melsetter Border Belt, lying almost entirely in Mozambique territory, but affecting certain farms on the Melsetter border.

The author then gives a detailed account of the extension of the fly in each of these areas. Formerly tsetse fly used to occupy a very much larger portion of the territory than it does at present. The great shrinkage as is well known occurred at the time of the rinderpest epizootic in 1896. A knowledge of the country formerly inhabited by the fly is of considerable value at the present time when the pest is steadily advancing in certain areas as it enables one to judge what particular parts are threatened with invasion. The history of the fly in South Africa indicates that country that has been settled and noticeably "tamed" need fear no invasion for, although there are numerous records of civilisation pushing the fly before it, the writer is unaware of a single instance of the reverse process. Exception must be made in the case of isolated farms where the immediate surroundings are wild and are haunted by big game. The author is convinced that infection by flies other than tsetse is of comparatively frequent occurrence in the territory and that the greatest care should be taken to prevent fly struck cattle coming into contact with healthy herds especially in the summer months when blood-sucking flies are abundant. As a general rule, however, outbreaks of this nature die out in the ensuing winter when blood sucking flies become scarce. Although the continued spread of tsetse in certain portions of the territory is undoubtedly creating a serious position locally the public is advised to discredit without hesitation any reports which suggest danger to the settled areas. The position is that merely certain areas adjacent to the Sebungwe fly area, which are either marked off as native reserve or not yet settled by Europeans to any extent, are apparently in danger of becoming included in the fly country and so being rendered more or less useless for pastoral and agricultural purposes until the advance of civilisation finally drives back the flies, as has already been the case in South Africa. It is stated that there is not the slightest danger of any overwhelming calamity due to the spread of tsetse. During the wet season the fly appears to flood, as it were, beyond its previous limits and then on receding leaves beyond its original confines a series of small circumscribed fly areas comparable to the pools scattered over land during the receding of a flooded river.

Report of the Government Entomologist on the Spread of the Tsetse Fly and Trypanosomiasis in the Wankie District.—*British S. Africa Dept. Agric. Salisbury,* 23rd June 1918. (MS. Received from the Colonial Office 10th October 1918.) [Extracted in *Rev. Appl. Entomol.* 1919. Jan. Ser. B. Vol. 7. Part. 1. pp. 9–10.]

"The results of investigations into tsetse-fly conditions in various localities of the Wankie District of Southern Rhodesia are reported and discussed.

The problem of dealing with the increase in abundance of the fly [*Glossina morsitans*] and the consequent spread of trypanosomiasis has become a serious one. The suggestions made as to the measures calculated to check the fly include :—(1) Throwing open a guard area to free shooting. This it is believed would probably do more harm than good, as it would almost undoubtedly lead to poaching in neighbouring fly country with the result of driving game back into the open area ; while a remote area would never be thoroughly cleared by professional hunters for the reason that it would not pay. (2) Organised destruction of game, by driving big game from a guard area and keeping that area free. By this means a state of equipoise might be reached between the tendency of the fly to spread and human efforts to keep it back. This would entail the permanent employment of one or more wardens with a staff of native hunters, and is considered to be out of the question. It is thought, however, that a properly organised attack on the whole area invaded or threatened by tsetse-fly would have an excellent chance of success.

"This idea involves the wholesale extermination of game, first around the boundaries of the infected area and gradually towards the centre, and such an undertaking appears both feasible and economically sound. (3) Deforestation of a guard area. A difficulty about this scheme is that it is not known how wide a cleared area would prove an effective check ; it is thought that the cleared strip should be at least 200 miles long and would consequently cost a large sum of money to establish and maintain, while it would very likely prove ineffective. (4) Deforestation of a strip of country, perhaps a mile wide, fenced on both sides to prevent game crossing over. While this might be an effective barrier it would be far too expensive in construction and maintenance and too doubtful in result to be worth serious consideration. (5) Destruction of winter haunts in threatened areas. It is suggested that as the fly is dependent during the time that the trees are leafless upon evergreen trees in the vicinity of water courses, the removal of such trees would probably render the locality unsuitable as a permanent fly belt.,

"In conclusion it is pointed out that no method of definitely checking tsetse is known, and any measures taken must be in the nature of experiments. The necessity for beginning dipping experiments in relation to tsetse-fly as quickly as possible is emphasised."

JACK (Rupert W.). **A Form of Myiasis in Cattle.**—*Rhodesia Agric. Jl.* 1918. Dec. Vol. 15. No. 6. pp. 539–540. With 1 plate.

In this article the author gives a short popular account together with a good plate representing the life-cycle of an apparently new species of fly bred out by him from maggots stated to have been taken from large cavities in the subcutaneous tissues of cattle in the Mazoe Valley, Southern Rhodesia. The fly itself was of the bluebottle type, the whole of the body being of a dark but brilliant metallic blue. The length of an average specimen, from the front of the head to the tip of the abdomen, was about 9 mm. The head was laterally of a buff colour and the wings were free from the dark markings of the common allied species (*Pycnosoma marginale*). The greatest length of the larvae examined was about 14 mm. while the average pupal length was about 11½ mm. The larvae showed a series of thickened bands in the region of the segmentation and these bands were armed with numerous stout recurved hooks pointing backwards towards the thicker posterior end of the body. The pupal stage lasted about 14 days in the specimens bred. It is probable that these flies breed as a rule in decaying animal matter. The Chief Veterinary Surgeon, Southern Rhodesia, recommends treatment of affections set up by these maggots with chloroform or peroxide of hydrogen, taking care

that the fluid gains access to all the cavities caused by them. Any of the carbolic disinfectants in common use may be applied and a decoction of peach leaves is said to be very useful. After this treatment the wound should be dressed with carbolic ointment or Stockholm tar with a view to preventing further infestation.

HADWEN (S.) & CAMERON (A. E.). **A Contribution to the Knowledge of the Bot-Flies,** *Gastrophilus intestinalis,* DeG., *G. haemorrhoidalis,* **L., and** *G. nasalis,* **L.**—*Bull. Entomol. Res.*, 1918. Sept. Vol. 9. Pt. 2. pp. 91–106. With 9 text figs. and 1 coloured plate comprising 3 figs.

"Recognising the scantiness of the knowledge pertaining to the early stages and habits of the three common species of bot-flies, the authors had in mind in this work the elucidation of several obscure points, more particularly relating to the hatching of the eggs, the form and behaviour of the first-stage larvae, the specific regions of the host selected by the different flies in ovipositing, and the manner in which the persistent attacks of the flies affect their hosts psychically."

The authors summarise their investigations as follows:—

"The eggs of the three species of bot-flies discussed in this paper are distinguished by the fact of that of *G. haemorrhoidalis* being the only one stalked. It is also longer than those of the other two species, which are of about equal length. Further, it is brownish black in colour, that of *G. intestinalis* being whitish yellow and *G. nasalis* yellow. The egg of *G. intestinalis* adheres to the hair by clasping flanges, which run only two-thirds of its length, whilst the flanges of the *G. nasalis* egg run almost the entire length.

The egg of *G. haemorrhoidalis* is not inserted nor screwed into the skin of the host. The eggs of *G. intestinalis* are laid indiscriminately on the body of the host, but preferably on the long hairs investing the inside of the foreleg. *G. nasalis* lays its eggs on the hairs of the intermaxillary space, and *G. haemorrhoidalis* on the hairs of the lips, preferably the lower.

"Of the recently emerged larvae, that of *G. intestinalis* is largest in size and *G. haemorrhoidalis* smallest. In these two species there are 13 body segments, whilst *G. nasalis* has but 12 and is the only one bearing slender, elongate hairs. The larval posterior spiracles of the latter species are sessile; whereas in the others the two spiracles are borne on the distal ends of two cylindrical processes arising from the ultimate abdominal segments.

"The eggs of *G. intestinalis* do not readily hatch unaided, but apparently require the application of moisture and friction or shock. A large number of *nasalis* eggs hatched spontaneously and a few of the *haemorrhoidalis* eggs also. This latter fact is regarded as supporting the theory that the newly emerged larvae of these two species may penetrate directly into the integument of the host. The lesions on the skin of the intermaxillary space and lips of the host observed at the time the eggs were hatching may be due to direct penetration of the larvae of *nasalis* and *haemorrhoidalis* respectively.

"The newly emerged larvae of *intestinalis* failed to penetrate the hair-bearing integument of the host, but positive results were obtained when they were placed on portions of the buccal mucosa of a horse and calf recently killed. A larger number succeeded in penetrating the papillated portion of the calf's tongue, as compared with the unpapillated.

"The three species are probably present in each of the western provinces of Canada.

"As regards their seasonal appearance, *intestinalis* is somewhat later than *nasalis* and *haemorrhoidalis*, which appear simultaneously and are on the wing for about the same time.

"*G. intestinalis* continues to be active far into the autumn.

"Of the three species, *intestinalis* causes the animal less apprehension than the other two.

"The provision of leather-flaps on the lips of the horse, cut into strips, comb-wise, is advocated as likely to give good results in warding off the attack of *G. haemorrhoidalis*."

COMMONWEALTH OF AUSTRALIA ADVISORY COUNCIL OF SCIENCE AND INDUSTRY. 1917. Bull. No. 1. 30 pp. With 4 plates.—**The Cattle Tick in Australia.** [Extracted in *Rev. Appl. Entomol.* 1919. Jan. Ser. B. Vol. 7. Pt. 1. pp. 12–14.]

"*Boophilus australis* (cattle tick) may affect the health of cattle in two distinct ways, namely by conveying tick fever and by the irritation, etc., caused by its presence. This fact of the tick being capable of giving rise to sickness *per se* by gross infestation, has not always been recognised, and early records of the pest refer almost exclusively to tick fever. The particular form of piroplasmosis known as tick fever in Australia is due to *Piroplasma* (*Babesia*) *bigeminum*, which is also the cause of Texas fever in the United States of America and similar diseases in Europe, Asia, South America and South Africa.

"It is considered probable that this pest was introduced into America by cattle imported by the Spaniards during the early colonisation of Mexico. Circumstantial evidence points to the importation of Brahma cattle from Batavia into Australia in 1872 as being the source of Australian infestation.

"This bulletin deals at length with the life-history of the tick, tick infestation, tick fever, its treatment, and measures of protection against it. Of these, artificial inoculation confers immunity for a period of 1 to 2 years, or occasionally longer in individual cases. An inoculated individual, however, acts as a reservoir of infection, and since all ticks are not infective, there is little doubt that protective inoculation has been an important factor in the dissemination of tick fever in certain centres in Queensland. In New South Wales an official embargo exists against inoculation, as, with the exception of a single locality on the Queensland border, infective ticks are not known to exist in that State.

"The loss from mortality caused by tick fever in Queensland alone is estimated at £7,000,000 sterling, and considerable loss from this cause has also occurred in the Northern Territory and Western Australia. Further, the affected States have suffered considerable direct loss from deaths due to tick worry, interference with the natural increase of the herds, retardation of growth and improvement of stock, and from diminished production of meat, milk and dairy products. The decrease in the value of leather production of Queensland amounts to about £114,000 for one year alone. Apart from these direct losses, the expenditure occasioned in connection with the erection and maintenance of dipping vats, and general disturbance of stock business, is also very considerable. The cost to New South Wales of putting into operation restrictive measures has amounted for the past 5 years to £123,480. Moreover the value of land in infested and adjoining areas has depreciated even up to 40 per cent., and when the extent of acreage involved is considered, this loss alone becomes stupendous.

"The general methods of tick eradication directed against the pest in its free existence are the 'starving-out method,' usually combined in practice with the 'pasture rotation' system. By this means all possible hosts of the tick are excluded from pastures until sufficient time has elapsed for the tick to die out and the eggs to perish, the cattle being removed systematically to clean pastures before the eggs laid by the matured females dropping from them have time to hatch out. The land thus vacated is immediately placed under cultivation, and is not re-stocked until it may be assumed to be tick-free. Field observations in the north-coast districts of New South Wales indicate that this period exceeds one year.

"The most efficacious direct method of dealing with the pest is by attacking it during its parasitic existence by hand-picking and grooming or by hand-dressing and spraying, or by dipping, the last being the only practicable way of treating unhandled cattle and horses. It is also the cheapest method for the treatment of large numbers. Experience has shown that arsenic is the only reliable tick-destroying agent, there being several efficient official formulae for arsenious cattle dips, such as:—Queensland Cattle Dip 'A,'—Arsenious acid 8 lb., caustic soda 4 lb., Stockholm tar ½ gallon, tallow or oil (animal or vegetable) 4 lb., water 400 gals.; Queensland Cattle Dip 'B,'—Arsenious acid 8 lb., caustic soda 4 lb., bone oil 1 gal., water 400 gals.; New South Wales Dip,—Arsenious acid 8 lb., washing soda 12 lb., common hard soap 2 lb., Stockholm tar (best) ½ to 1 gal., water—add to 400 gals.

"The effect of these arsenical preparations is not immediately noticeable, and for eradicating the pest the treatment must be continuous and systematically carried out, dipping being practised every fifteenth day. The tendency is for owners to stop treatment too soon, with the result that eradication is often approached but not accomplished.

"The success that has attended tick-eradication work in the United States is primarily due to the educational campaign. The treatment adopted is thoroughly and systematically applied, and, as eradication is aimed at in America, the yards, dipping vats and other structures used in connection with the work are not of a permanent character, and are therefore cheaper, which means that more are acquired for a given outlay. The work has been greatly facilitated by the Federal authorities assuming control of stock and of satisfactory fencing operations, by the existence of an extensive system of railways, and, to a material degree, by the severity of the winter weather being inimical to tick life.

"In New South Wales, the main operations have so far aimed at keeping the tick from spreading south, and there does not appear to be any prospect of complete eradication of the pest under the existing disabilities which are inseparable from State Administration. Even when it has been accomplished, as has been the case in two large areas, there is always the risk of re-introduction from Queensland, unless extermination is effected there also. Many of the difficulties that militate against eradication in New South Wales obtain in Queensland in an accentuated form, and there seems but little likelihood of the tick being exterminated until operations are sustained by Federal intervention."

HILL (B. J.). **Note on the Analysis of Soda-Sulphur Dips.**—*S. African Jl. Sci.* 1918. June. Vol. 14. No. 11. pp. 474–476. [Extracted in *Rev. Appl. Entomol.* 1918. Nov. Ser. B. Vol. 6. Pt. 11. p. 224.]

"One of the many soda-sulphur concentrates sold in South Africa for use as a sheep-dip for the eradication of scab, is described as lime-sulphur dip, although calcium is practically absent. Since sodium polysulphide is just as valuable as calcium polysulphide (if not more so) in the treatment of scab, nothing is to be gained by such confusion of specification.

"Carbonate, hydroxide, and polysulphide (tetra or penta) can co-exist in solution without immediate interaction. A little carbonate is therefore of no consequence in a freshly-made dip, but it is possible that on pro'onged storage, a slow reaction with polysulphide may take place with possible formation of depilatory hydrosulphide. This point, however, has not yet been specifically investigated.

"In reporting upon the efficacy of a soda-sulphur concentrate in relation to the eradication of scab, the content of polysulphide sulphur should be made the basis of calculation. Other constituents, such as thiosulphate, are of negligible parasiticidal importance, and need not be considered in evaluation. The dilution recommended for tank strength should be such that the polysulphide does not fall below 0·6 to 0·7 per cent."

BACTERIAL DISEASES.

KNOWLES (R. H.). **Treatment of Ulcerative Lymphangitis by Vaccines made from the Preisz-Nocard Bacillus prepared with Ethyl-Chloride.**—*Jl. Comp. Path. & Therap.*, 1918. Dec. Vol. 31. Pt. 4. pp. 262–272 with 4 tables.

Treatment of ulcerative lymphangitis by means of vaccines consisting of dead Preisz-Nocard bacilli has previously been carried out by MONTGOMERY, TRUCHE, and WATSON with varying degrees of success. TRUCHE employed a mixture of alcohol and ether for killing his organisms. Knowles employs ethyl chloride, recommended by CAMUS, and BERTHELOT and BERTRAND, inasmuch as it is more volatile, less soluble in water and has a lower boiling point than ether or chloroform.

Pure cultures of the Preisz-Nocard bacillus isolated from ten different sources, are obtained on horse serum agar after incubation at 37° C. for 48–72 hours. The growth is then scraped off with sterile precautions, weighed and emulsified in a mortar with a few c.c. of ·75 per cent. salt and ·5 per cent. carbolic acid solution. The resulting emulsion is placed in a large test tube provided with a well-fitting rubber bung. The tube is placed in an ice box containing broken ice and salt. The temperature is noted by immersing a thermometer in a similar tube placed in the ice box and containing as much water as the other contains bacterial emulsion. When the temperature registered is approaching freezing point ethyl chloride is added to the bacterial emulsion, the volume added being equal to that of the volume of emulsion. The bung is firmly replaced, the emulsion shaken, and then left in the ice box for 48 hours. It is then removed and a sterile cotton wool plug is substituted for the bung. The tube is now placed in tepid water (25 to 30° C.) to drive off the ethyl chloride, leaving the original volume of bacterial emulsion, which contains a known weight of the bacteria. The emulsion is then diluted with salt and carbolic solution so as to contain 5 mg. of bacteria per c.c.

The vaccine was administered subcutaneously on the right and left sides of the neck alternately every seven days. All cases were kept under treatment for a minimum period of six weeks during which they received at least seven doses of the vaccine.

In order to arrive at the most suitable doses a varying quantity of the vaccine was given, and the different results observed were with regard to:—(1) the course of the disease including the nature and extent of the lesions, the appearance of fresh abscesses and the progress of the old lesions; (2) thermal reaction—temperatures were taken every 12 hours after the injection of the vaccine for a period of 60 hours; (3) the local lesion at the seat of injection of the vaccine.

During the course of the vaccine treatment the local lesions were washed with a solution of creosol and irrigated with sterile salt solution. Walking exercise was given daily. Measures were taken in order to endeavour to trace the animals after their dispersal among various units. The disease was diagnosed in most cases by naked-eye inspection, but in cases which did not present typical lesions a cultural examination was made.

The horses treated fell into four groups.

The first group consisted of 37 cases and these were given a first dose of 2 c.c. (10 mg.) which was increased every seven days by 0·5c.c. The dose was not increased beyond 3·5 c.c., inasmuch as doses exceeding this appeared to produce too pronounced negative phases. In the case of horses that were not cured at the end of six weeks the vaccine treatment was stopped for a fortnight. It was afterwards resumed, commencing with 1 c.c. (5 mg.) and increasing by·25 c.c., with a maximum of 2·5 c.c. All the cases in this group had been under treatment without vaccines for varying periods, in most cases for some months. There were 29 recoveries, 8 failures, 4 recurrences, giving a "percentage cured and not recurred" of 67 per cent. The period taken for recovery to take place varied from three weeks to three months. The seven animals which took over eight weeks to recover had been suffering from the disease for some months prior to vaccine treatment. Three out of four recurrences occurred in cases which had been suffering from the disease for over three months before the vaccine treatment was commenced. In a very considerable number of cases the time taken for recovery under vaccine treatment was markedly shorter than the known duration of the disease prior to the treatment.

Group 2 consisted of 44 cases. The initial dose was 1 c.c. (5 mg.) increasing every seven days by 0·5 c.c. until 4 c.c. were given at the seventh case. In the case of animals which had not then recovered the treatment was stopped for a fortnight and recommenced with smaller doses, that is, commencing with 1 c.c. and increasing by ·25 c.c. every seven days up to 2·5 c.c. In this group there were obtained 33 recoveries, 11 failures, and 3 recurrences, giving a percentage cured and not recurred of 68 per cent. The average time taken for recovery was 37 days. From observations on the course of the disease and the thermal reactions it was decided that the dosage employed in this group was still too large and that many of the failures were due to a pronounced negative phase. Most of the cases shown as failures appeared to be responding well to the vaccine treatment up to the end of the third and fourth week but after this the appearance of fresh lesions indicated a too well-marked negative phase.

Group 3. This consisted of 40 cases. It was decided that the dosage used in this group gave the most satisfactory results, and it is the one now recommended. The initial dose was 1 c.c. (5 mg.), increasing by 1·25 mg. ($\frac{1}{4}$ c.c.) every seven days. In the case of animals which showed slow progress the dose was not increased over 2 c.c. until more satisfactory progress was made. Thus a small percentage of the cases in which progress was slow required a smaller dosage, "the object being," it is stated, "to keep the case in the positive phase of reaction to the vaccine." The number of recoveries was 28, failures 2, and recurrences 5, giving a "percentage cured and not recurred" after an interval of from three to four months of 82·5 per cent. The average time taken for a cure to take place was five weeks.

Group 4. This comprised 30 cases treated in the same manner as those in Group 3. The results were very nearly the same but a number of recurrences are anticipated. The results obtained at the

time of writing were 26 recoveries and four failures, no recurrences, giving a " percentage cured and not recurred up to date " of 86·6 per cent.

A comparison of a series of cases treated (a) without vaccines, (b) with vaccines, are given below.

	Without vaccine.	With vaccine.
Number treated	173	151
„ cured	73	124
Percentage cured	41%	82%
*Number recurred	—	8

*Without vaccine, exact number not known, but it was thought that many of these cases recurred.

VAN SACEGHEM (R.). **Traitement de la Lymphangite ulcéreuse.** [Treatment of Ulcerative Lymphangitis.]—*Bull. Soc. Path. Exot.*, 1918. Oct. 9. Vol. 11. No. 8. pp. 683–690.

A number of various methods of treatment have been devised for ulcerative lymphangitis—pyo- or auto-pyo-therapy (BELIN and VELU), leucocyto-therapy (BRIDRÉ), vaccines (TRUCHE)—but no specific treatment has hitherto been found. The author obtained recoveries after an injection of staphylococcic pus treated with ether into infected horses, thus indicating that the procedures recommended by BELIN and VELU were not in reality vaccinations; the curative effects of these treatments would appear to depend more particularly on the intense leucocytosis set up by them.

The method of treatment now recommended by the author is as follows. The pus to be utilised for treatment is collected with sterile precautions from abscesses set up by the injection of pure cultures of the causal organism subcutaneously. Equal parts of oil and sulphuric ether are added to this pus and shaken up in a bottle so as to obtain a homogeneous mixture, which is then passed through fine muslin and shaken from time to time. After 48 hours the overlying liquid is decanted away and the pus may be used for injection intravenously.

Three c.c. are given as a first injection, and then 5 c.c., 7 c.c., and more at further injections. A rise in temperature rarely exceeding 1° C. is obtained and lasts at the most three days. As soon as the temperature becomes normal the treatment is repeated. After each series of five injections the treatment is suspended a few days. Recoveries are brought about in this way but the horses are not immune to reinfection.

DALLING (T.). **Investigations on Specific Ophthalmia, in Continuation of the Observations made whilst in the Abattoir, Paris (Dec. 7th, 1918).**—*Vet. Jl.*, 1919. Jan. Vol. 75. No. 1. pp. 16–24.

Examination of a number of sections from the optic nerves of horses affected with specific ophthalmia had revealed to the author what were apparently short bacilli lying " in the lymphatic spaces between the nerve fibrilae " in nearly all the sections examined.

Inoculation of culture media from material taken with sterile precautions from the optic nerve of an affected animal showed just visible growth four days afterwards, which proved to be a pure culture of an organism called by the author the "nerve bacillus." Subsequently, at Havre, the author succeeded in cultivating the above organism in pure culture from the optic nerves of eight horses that had suffered from ophthalmia. In only one case was the growth contaminated—with *Staphylococcus aureus.*

The organism is described as a cocco-bacillus, 1 to 2μ in length by ·5 to 1μ in breadth, often attached end to end in pairs, motile, staining well with the aniline dyes, not acid-fast, Gram negative. It grows on nearly all the ordinary culture media both aerobically and anaerobically, but best as an aerobe. When material from an optic nerve is sown on agar incubated at 37° C. no visible growth can be seen for three days. On the fourth day minute white specks are seen which gradually increase in size and finally coalesce to form a translucent moist film. On sub-culture the growth is more rapid and visible colonies are seen after 18 hours' incubation. After several days' incubation the medium develops into a bluish-grey moist-looking viscid mass which turns darker in colour as it grows older. Stab sub-cultures in gelatin kept at 21° C. show after 48 hours minute white spots along the needle track which later coalesce to form a greyish line. Liquefaction of the medium commences about the fifth day, and the whole mass becomes liquified simultaneously down to the level of the bottom of the growth. The medium then appears to be divided into three layers, viz., on the top a cloudy yellowish liquid gelatin, a yellowish flocculant mass, lying over clear solid gelatin at the bottom of the tube. No gas formation takes place. Plate cultures in gelatin show visible growth in about 48 hours and subsequently liquefaction quickly takes place with the appearance of greyish yellow masses floating in the liquid gelatin. No growth is visible in plain broth incubated at 37° C. for 36 hours, but then the medium gradually becomes cloudy and a delicate opalescent film develops on the surface. This film falls to the bottom and collects as a small yellowish deposit. The broth remains turbid on continued incubation, with a thick yellowish deposit at the bottom. The organism also grows on solid blood serum but the growth is not so vigorous as on plain agar. A visible growth is obtained on potato but it is much less scanty than on the above media.

Experimental.—Guinea-pigs and rabbits inoculated subcutaneously, intraperitoneally, and intravenously with small doses of young culture developed no symptoms. Two guinea-pigs inoculated with ·5 c.c. of a seven days' broth culture intravenously immediately showed symptoms—inappetence, diarrhoea, and emaciation. On the third day both eyes were closed and there was thick muco-pus below the inner canthi and intense conjunctivitis. One animal died in four days and the other was destroyed. No lesions were found post-mortem except iritis in all the eyes and opacity of the cornea of one eye in one animal. The so-called "nerve bacillus" was easily demonstrable microscopically and culturally in the optic nerves.

The corneae of several horses were painted with emulsions of the organism but nothing resembling specific ophthalmia was subsequently

noted during an observation period of two months. The inoculation of cultures into the supra-orbital fossae of several horses gave no result over a similar period of observation except local abscesses in two cases.

Four horses inoculated intravenously with emulsion of a 24-hour growth on agar refused food during the first 24 hours, developed temperatures of up to 103·5° F., and then became normal. Two developed slight conjunctivitis. Three weeks later these horses were given a larger dose of a similar emulsion intravenously and then presented symptoms of a severer nature, which disappeared. Three weeks later intravenous inoculation with 10 c.c. of a seven day old broth culture produced very marked symptoms—dizziness, increased respiration, severe abdominal pains and violent diarrhoea within ten minutes after infection; the animals then lay prostrate for several hours but one animal died in a few minutes after the inoculation and on post-mortem examination it showed enlargement of the spleen and marked iritis in both eyes. In the other three animals the symptoms gradually abated and they became normal after two days except that a very acute conjunctivitis was set up within six hours after the inoculations; the eyelids were closed and swollen and a watery discharge exuded. The eyelids gradually opened after 12 hours but the conjunctivitis persisted for several days. The iris on examination was found to be paralysed and thickened, of a dull appearance, and failed to respond to light. One of the animals subsequently became blind and another showed a distinct adhesion between the lens and the iris. [The author apparently did not have in mind the phenomenon known as anaphylaxis, which would explain the production of some of the early severe symptoms in these animals sensitised by the initial dose of his organism.—Ed.]

Similar results to those obtained in the last mentioned experiment were obtained with another series of three horses inoculated with broth cultures of the organism. The results thus appear to indicate that the organism showed greater virulence in older cultures, probably due to the development of a greater quantity of toxin. Two horses inoculated subsequently with 2 c.c. of a ten days' old broth culture intravenously developed very marked toxic symptoms. One animal recovered from these in three days but the other did not recover its appetite for over a week. The first animal showed acute conjunctivitis lasting several days leaving a thickening and paralysis of the iris. The second animal also showed acute conjunctivitis for three days and distinct adhesions between the lens and the iris with occlusion of the pupil in both eyes and, subsequently, complete blindness.

Feeding experiments were undertaken with two horses, to which were administered on two successive occasions balls containing a ten days' old broth culture. One animal showed distinct irritation in both eyes and photophobia. These experiments are not yet complete.

The author reports distinct improvement in five cases of acute specific ophthalmia following upon treatment by means of vaccines prepared from the organism. He then describes a somewhat crude method by means of which he endeavoured to ascertain the agglutinating effects of sera from normal and affected animals upon the organism isolated by him. The serum from horses inoculated with the organism intravenously produced agglutination in 1–50

dilutions (and probably higher) in half an hour; serum from horses clinically affected with specific ophthalmia, complete in 1–10 dilutions in half an hour, and 1–50 in two hours; serum from horses which had recovered from acute ophthalmia, similar result; serum from horses which had had acute ophthalmia and had been "cured" by vaccine, complete in 1–10 dilutions in three-quarters of an hour and in 1–50 in two hours [This result is, of course, of no significance.—ED.]; serum from horses which had had ophthalmia and had been cured by the injection of "914," complete in 1–10 dilution in a quarter of an hour, and 1–50 in one and a half hours; serum from horses which had never shown any clinical symptoms of ophthalmia, that is, normal animals, no agglutination even in 1–10 dilution. These tests would appear to indicate that animals naturally affected with specific ophthalmia develop agglutinin in their blood capable of acting upon the "nerve bacillus."

ALLEN (J. A.). **A Preliminary Note on Infectious Keratitis.**—*Jl. American Vet. Med. Assoc.*, 1919. Jan. Vol. 54. (New Series. Vol. 7). No. 4. pp. 307–313. With 1 text fig.

Outbreaks of infectious bovine keratitis have been reported in India, Holland, South Africa, United States of America, and in the western and eastern provinces of Canada.

The symptoms described in these widely separated localities show a striking similarity. The disease appears to have been first investigated systematically by BILLINGS (Frank S.) in Nebraska in 1888. In stained sections of the diseased cornea this author discovered a short thin pleomorphic bacillus with rounded ends. The organism was obtained in pure culture but no attempt was made to reproduce the disease experimentally with it as previous experiments in which the exudate from the diseased eye was transferred to the eye of a healthy animal resulted in absolute failure, even after the cornea had been previously scarified. The same writer concludes, however, that this evidence was not sufficient to disprove the infectious nature of the affection.

A number of outbreaks have recently occurred in Manitoba, where it was first reported by HILTON in 1904 extending over a distance of about 40 miles. As a rule about 50 per cent. of each affected herd developed the disease. Many of the animals became permanently blind as the result of the corneal ulceration. MITTER (Satyendra Nath) in Bengal (1915) as a result of his investigation into an outbreak of contagious ophthalmia among conservancy cattle in which the cornea was seriously involved stated that the disease appeared to be caused mainly by *Micrococcus lanceolatus* and partly by the MORAX–AXENFELD bacillus; the period of incubation varied from 3 to 7 days. This author found it impossible to reproduce the disease in experimental animals and concluded that the organisms isolated had no action on unbroken conjunctiva but when brought into contact with an abraded surface they were liable to produce the disease. The condition was also investigated in Holland by POELS (J.), who assumed that the virus could not be found in a virulent form in the exudate, which, he stated, was the result of a hypersecretion of the eyelids. Further, he reported

that when the organism encountered by him was found in the secretion, as in the case of slight affections, cultures could not be obtained from his material because the bacilli had died as the result of bacteriolysis. Microscopic preparations from the diseased cornea, however, showed enormous numbers of bacilli morphologically similar to *Bacillus pyogenes*, and a growth similar to that obtained with this organism was obtained on culture. The disease could not be reproduced by the instillation of *B. pyogenes* cultures on to the cornea but when injected between the layers of the cornea a typical case of keratitis was set up. This result was not astonishing inasmuch as the organism is found in inflammatory conditions in various organs in cattle, having been demonstrated by POELS himself in 38 out of 56 such cases. POELS concludes that *B. pyogenes* is the true cause of keratitis infectiosa in Holland.

Working under the direction of the Dominion Department of Agriculture, Canada, Allen investigated a limited outbreak of an apparently infectious eye disease in a herd of cattle in Quebec. The symptoms first seen were marked lachrymation, photophobia, and congestion of the circumcorneal vessels and those of the conjunctiva. There was very little constitutional disturbance; only in one experimental animal was a noteworthy elevation of temperature observed (104·4° F.); in a few days the pain became more intense and the cornea took on a smoky haze which in all cases began at a point just under the centre of the cornea and ultimately spread over the entire surface. Four or five days later the opacity became denser with resulting impaired vision. Some of the animals at this stage showed signs of recovery but in other cases the infiltration became even denser, the opacity assumed a yellowish colour, and a fringe of blood vessels appeared on the marginal part of the cornea. In cases which showed improvement absorption of the intracorneal exudate began at the periphery and gradually extended towards the centre of the cornea. A marked symptom was the appearance of small protuberances upon the surface of the third eyelid. Very little improvement was shown under treatment and signs of ulceration were observed.

In direct smears made from the watery extract it was possible to demonstrate a short, thick, Gram-negative diplobacillus, which was present in somewhat sparing numbers. Frequently the bacilli were found in clumps. There was very little pus formation but when a particle of pus could be obtained for examination the diplobacilli were fairly plentiful and were found lying between the leucocytes.

Sterile swabs were saturated with the secretion from the diseased eye and were immediately passed lightly over the conjunctiva of a healthy heifer. In six days intense lachrymation and photophobia were manifested and in a few days the animal presented the appearance of a typical case of keratitis. The disease was also set up in a young bull in eight days after swabbing the cornea in a similar manner. A diplobacillus was demonstrated in smears made from the exudate of these experimental animals. Similar experiments conducted with rabbits and guinea-pigs gave negative results.

The biological characters of the organism were briefly as follows:— It was about 2 μ long by 1 μ broad occurring in pairs placed end to end. It

stained with all the common laboratory dyes, and was Gram-negative. On solid blood serum small depressions appeared in 12–20 hours due to liquefaction. When first isolated complete liquefaction took place in about five days, in sub-cultures this occurred more rapidly. Primary cultures could not be obtained on agar but sub-cultures grew quite luxuriantly, giving a greyish film-like growth which became wrinkled with age. The organism grew best at body temperature but appreciable growth was obtained at room temperature. A pure culture instilled on to the eye of a calf failed in 14 days to produce symptoms. The bacillus described above exhibits several of the prominent characters of the organism associated with infectious conjunctivitis in man, which was described by MORAX and independently by AXENFELD in 1896.

DISEASES DUE TO FILTERABLE VIRUSES.

FRIEDBERGER (E.). **Ueber den Einfluss von Desinfektionsmitteln auf invisible Virusarten. II. Das Verhalten des Virus der Vogelpocke (Epithelioma contagiosum) gegenüber verschiedenen Desinfektionsmitteln nebst Untersuchungen über des Wesen der Krankheit.** [The Influence of Disinfectants on the Ultra-Visible Viruses. ii. The Behaviour of the Virus of Fowl Pox (Epithelioma Contagiosum) towards various Disinfectants, with Experiments upon the Nature of the Disease.]—*Ztschr. f. Immunitatsf. u. Exper. Ther.*, 1. Teil. Orig. 1918. Dec. Vol. 27. No. 6. pp. 459–488. With 23 tables.

Fowl pox belongs to a class of diseases the symptoms and lesions of which are characteristic and have been well studied although the cause still remains in complete mystery. In a similar disease of man—molluscum contagiosum—cellular inclusions in the epithelial lesions were described long ago by VIRCHOW and BOLLINGER and these have been held by others to have been parasitic in nature. The discovery of the filterability of the fowl pox virus by MARX and STICKER (1902) contra-indicated the primary parasitic nature of these bodies in the epithelial cells of the pigeon. Owing to their staining properties, resembling those for fat, these bodies have since been held to have been a mixture of lipoids and proteins. BORREL (1914) and later other authors have placed in evidence by special methods small bodies about $\frac{1}{4}\mu$ in diameter staining with Giemsa but Gram negative, sometimes occurring singly, sometimes in chains, and sometimes surrounded by a clear halo. The etiological significance of these bodies has hitherto not been determined inasmuch as the filterability of the virus does not necessarily exclude them as causal agents. VON PROWAZEK succeeded in arresting them by ultra-filtration and held that they were epithelial parasites with reaction products surrounding them and of the nature of chlamydozoa. LIPSCHÜTZ demonstrated the presence of the virus in the internal organs although no lesions were set up in them and thus the virus only

showed for the skin a specific afinity and set up a specific reaction in it (dermotropism). The cause of the disease was thus designated as a strongyloplasma. No method of cultivating the virus has hitherto been discovered. Although the nature of the cellular inclusions is not determined there appears to be no doubt as to the contagiosity of the disease, which amounts to 100 per cent. of cases and is successful even with 20,000 dilutions. The incubation period lasts five to six days after instillation on to the eyes and only 24 hours after inoculation into the skin of the breast. The blood and internal organs are virulent ten days after skin infection and remain virulent for up to four weeks after the skin lesions have disappeared. SANFELICE (1913) demonstrated the virus in the internal organs 24 hours after skin infection and in the internal organs up to 71 days afterwards. The disease sets up an immunity; the blood serum, however, contains no anti-bodies against the virus. SANFELICE held that the contagion was probably a fluid virus of the nature of a nucleo-proteid which could be obtained from infected skin in a virulent form even after treatment with 1 per cent. caustic potash for 24 hours. This chemical agent is destructive for anthrax spores within a much shorter period.

Some facts concerning the resistance of the fowl-pox virus are already known. In the desiccated epithelial lesions the virus is demonstrable after 18 months (LIPSCHÜTZ); at $-12°$ C. it is destroyed in five weeks. In desiccated masses it resists heating at 60° C. for three hours and 100° C. for one hour (MARX and STICKER); it remains alive in glycerine at least 120 days (BURNET); 10 per cent. formalin does not completely destroy it in 24 hours (UHLENHUTH); 10 per cent. atoxyl, 1 per cent. saponin, 10 per cent. sodium taurochlorate are not destructive (LIPSCHÜTZ, VON PROWAZEK, and DE BEAUREPAIRE); 1 per cent. caustic potash, 1 per cent. acetic acid, ½ to 1 per cent. carbolic acid, and 1 per cent. corrosive sublimate destroy the virus in five minutes (SANFELICE), but in certain conditions it was found that 1 per cent. carbolic acid was not destructive in one hour. Radium does not destroy the virus in 5½ hours (LÖWENTHAL) and daylight on an admixture with 1 per cent. erythrosin does not destroy it in three days (JULIUSBERG).

In his experiments the author utilised the skin from the breast of a pigeon taken at the height of infection, usually eight to ten days after inoculation. One gramme of skin was cut up with sterile precautions, ground in a mortar with sterile sand, 20 c.c. of normal saline solution added, and the whole was mixed up so as to form a homogeneous emulsion. The mixture was then filtered through sterile filter paper. 0·5 c.c. of this filtrate was added to an equal quantity of the disinfectant to be tested. For purposes of control 0·5 c.c. of filtrate was mixed with 0·5 c.c. of normal saline solution. The tubes containing these mixtures were placed in the incubator. After half an hour and again after 18 hours equal quantities of the mixture were inoculated into the plucked skin of the breast of healthy pigeons by means of a sterile needle. It was considered unnecessary to eliminate the chemicals before inoculation; this could not be done by washing or centrifuging at high speed.

It appeared that approximately equal quantities of virus were utilised in all these experiments; inasmuch as extremely minute

quantities are known to be infective the exact quantity inoculated did not matter very much. The course of the infection in the experimental animals was observed from day to day.

In each comparative test 0·5 c.c. of the solution of disinfectant was mixed with 0·4 c.c. of the same fowl pox emulsion and 0·1 c.c. of a loopful of a two day agar culture of *B. prodigiosus* emulsified in 10 c.c. of sterile saline solution. Also 0·5 c.c. of the solution of disinfectant mixed with 0·5 c.c. of normal saline solution was always used as a control for inoculation. The tubes were likewise placed in the incubator and used for inoculation after half an hour and 18 hours and also sown on agar. The tubes inoculated remained three days at room temperature and were then read off.

The strength of the various dilutions of the materials tested required to destroy the fowl pox and *B. prodigiosus* are indicated in the Table on the following page. The results similarly obtained in the course of experiments with the vaccinia virus by the author and JAMAMOTO in 1913 are also included.

On examination of this Table it is seen that saponin exhibits a striking effect upon vaccinia and also that antiformin and hydrogen peroxide act somewhat more strongly on it than on the two others. On the other hand corrosive sublimate, silver nitrate, carbolic acid, and chloroform water are comparatively less effective towards it.

The fowl pox virus exhibits greater resistance to the disinfectants in all cases except those in which silver nitrate, sodium arsenate and sodium arsenite were employed. Sodium arsenite acts distinctly more strongly than sodium arsenate.

Most of the materials used acted with equal intensity on both viruses. It is noteworthy that arsenious acid was more destructive for *B. prodigiosus*, while this action was reversed in the case of the arsenic salts. The resistance of *B. prodigiosus* towards quinine was quite appreciably lower. It is also noteworthy that the resistance of the viruses towards bile and bile products was lower than that of *B. prodigiosus*, but, in this connection, one has to bear in mind that there are some bacteria such as the pneumococcus which are markedly susceptible to the action of bile. The above results do not demonstrate any special difference between the two viruses and bacteria but they indicate that, contrary to what has been set forth by SANFELICE, the contagion in the case of fowl pox is certainly of a living nature.

A series of experiments were then performed in order to obtain evidence as to whether the view held by SANFELICE regarding the fluid nature of the contagion as opposed to a *contagium animatum* held good. This author asserted that material from the lesions remained virulent after treatment with 1 per cent. caustic potash for 24 hours and subsequent neutralisation with 1 per cent. acetic acid. Friedberger, however, showed that when these substances were tested on the virus according to the technique above described by him the fowl pox virus was destroyed within five minutes by caustic potash and greatly reduced in virulence by acetic acid in the same time. The methods employed by SANFELICE were then repeated, the fowl pox material was ground with sand, mixed with four times its bulk of 1 per cent. caustic potash, allowed to remain 14 hours at room temperature, and filtered through linen. The viscid filtrate was mixed with

TABLE—*Lethal Concentration in ½ Hour and 18 Hours.*

Disinfectant.	Vaccinia.		Fowl Pox.		*B. prodigiosus.*		* Difference in the resistance of the 3 groups.		
	½ Hr.	18 Hr.	½ Hr.	18 Hr.	½ Hr.	18 Hr.	Vaccinia.	Fowl Pox.	B. prodigiosus.
1. Corrosive Sublimate ...	1/2,000	1/2,000	1/20,000	1/20,000	(1/20,000)	1/20,000	<	=	=
2. Silver Nitrate	> 1/200	1/2,000	1/200	1/20,000	1/200	1/2,000	<	>	<
3. Carbolic Acid	> 1/200	> 1/200	—	1/200	1/200	1/200	<	..	(<)
4. Saturated Chloroform Water	—	—	—	1/20	—	1/20	<	=	=
5. Formalin 40%	1/2,000	1/20,000	1/200	1/20,000	1/2,000	1/20,000	=	=	=
6. Antiformin	1/200	1/2,000	1/200	1/200	1/200	1/200	>		=
7. Hydrogen peroxide 30% ...	1/200	1/200	—	1/20	—	1/20	>		=
8. Quinine hydrochloride ...	..	> 1/200	—	> 1/200	(1/200)	1/200	>		<
9. Salicylic Acid	> 1/2,000	..	1/2,000	1/20,000	(1/20,000)	1/20,000	<		=
10. $As_2 O_3$	—	..	½	1/20	(1/20)	1/200	—	..	<
11. Sodium Arsenate	..	..	—	1/200	—	> 1/200	—	<	<
12. „ Arsenite	..	..	1/200	1/200	—	> 1/200	—	<	<
13. Tartar Emetic	..	> 1/200	—	> 1/200	—	> 1/200	=	=	=
14. Saponin	1/200	1/2,000	—	> 1/200	—	> 1/200	>		=
15. Sodium Oleate	—	> 1/200	—	> 1/200	—	1/200	=	=	(<)
16. Bile	..	1/1	(1/1)	(1/1)	—	> 1/1	(>)	=	<
17. Bile salts	..	1/1	(1/1)	(1/1)	..	> 1/1	(>)	=	<
18. Ether soluble portion of bile	..	1/1	(1/1)	(1/1)	..	> 1/1	(>)	=	
19. Bile mucin	..	> 1/1	..	> 1/1	..	> 1/1	=	=	=

* > Stronger Action. = Between two columns no difference. (>) (<) No appreciable difference in either direction.

twice its volume of 1 per cent. acetic acid. The flocculent colloidal deposit was collected on filter paper and washed with sterile distilled water and transferred on to the breast of a normal pigeon. As controls in this experiment a small quantity of the slimy filtrate was placed on the breast of a normal pigeon, and so-called nucleoproteid prepared in the same way from the skin of a normal pigeon was inoculated likewise on to another healthy pigeon. The pigeons inoculated with the nucleoproteid and slimy filtrate from the diseased skin developed fowl pox whereas the pigeon inoculated with material from the normal skin remained healthy. Friedberger proceeds to show that the positive results could only have been obtained through the failure of the chemical agents to act on the coarse particles that would be capable of passing through linen.

The failure to eliminate the infection from fluids by means of centrifugation does not necessarily indicate that the virus is of a fluid nature inasmuch as it might be constituted of extremely light fine particles. Ultra-violet light exhibits a somewhat lesser effect upon the fowl pox virus than upon *B. prodigiosus*. The addition of a fluorescent substance to the emulsion brings about a much enhanced effect. In the absence of fuchsin the virus is not completely destroyed in ten minutes whereas in the presence of 1–10,000,000 of this colouring material destruction is complete. In 20 minutes the virus is completely destroyed by the action of the rays; *B. prodigiosus* is killed in five minutes.

Burnet claims to have produced fowl pox lesions on the eyelids of birds by feeding them with the virus mixed with meal. Friedberger describes experiments in which pigeons were fed with virus, great care being taken that it did not come into contact with the skin. The results were negative.

Remlinger (P.). **La diffusibilité du virus Rabique.** [The Diffusibility of the Rabies Virus.]—*Ann. Inst. Pasteur*, 1919. Jan. Vol. 33. No. 1. pp. 28–52.

There appear to exist only three records of experiments dealing with the subject of the diffusibility of the rabies virus. Bŭjwid showed that the virus passed from a rabid calf brain to a healthy calf brain after having been kept in contact for a few days in an atmosphere freed from oxygen. Nitsch (1905) repeated this experiment, with success, and also showed that if the brain of a rabid rabbit was placed in distilled water or in normal saline solution the virus passed into the liquid after 23 hours. This author also stated that the virus was to be found in much larger quantity in the grey matter of the brain than in the white matter during the first stages of the disease and up to the time of death, but after death the white matter increased in virulence at the expense of the adjacent grey matter.

The following experiments were performed by Remlinger to ascertain the diffusibility of the virus outside the living body. The brains of rabbits that had died of rabies were washed with sterile water, placed in a vessel containing Locke's fluid for from one to three days and kept at 37° C. or at laboratory temperature. The liquid was then filtered through Chardin paper in order to withhold

the great majority of the contaminating organisms and 2 to 3 c.c. of the filtrate were injected into the neck muscles of the rabbit or guinea-pig. In a series of 15 experiments performed in this way in which 30 guinea-pigs were inoculated 20 remained healthy, three died of septicaemia following upon the inoculation, while seven succumbed to rabies.

This passage of the virus into Locke's fluid could not be accounted for by the multiplication or growth of the virus in the liquid inasmuch as the results were obtained even at a temperature of 10 to 15° C.

In one series of experiments positive results were obtained when the surrounding liquid consisted of 0·8 per cent. saline solution. Three animals died of rabies out of 30 inoculated. These experiments were conducted in exactly the same manner as in the case of those performed with Locke's fluid.

It might be held that the presence of the virus in the liquid was due to the disintegration of the brain matter as the result of decomposition but the following two series of experiments contraindicate this hypothesis. Putrefaction takes place at least as rapidly in olive oil or in oil from the fruit of *Argania sideroxylon* as in salt solution or in Locke's fluid, but when rabid brains were placed in either of these oils and kept as in the previous experiments the filtrate subsequently inoculated into rabbits or guinea-pigs, generally in 20 c.c. doses, failed to set up rabies. When putrefaction was suppressed by placing the infected brains in glycerine and then keeping as above, filtering and inoculating as before into rabbits or guinea-pigs the results were as follows. Out of 30 animals inoculated 19 remained healthy, 5 died of septicaemia following upon the inoculation, and 6 died of rabies.

Further experiments are recorded in which it is shown that the virus is capable of passing from an infected to a healthy brain kept in glycerine. The brains need not be kept in the dark for transmission to take place. Positive results were obtained in about one third of the experiments. It was also found that diffusion occurred to the same extent around the brain of a rabid dog as around those of the rabbit and guinea-pig. The virus was in addition found to be capable of passing into the brains of animals naturally immune to rabies, such as the fowl or the turkey. In the same way the virus was found to pass into the liver and kidney of healthy animals when these tissues were suspended in glycerine with rabid brains. The author then summarises the results of experiments which have already been referred to in this *Bulletin* [Vol. 6, No. 3, p. 184] showing that post-mortem diffusion of the virus in animals dead of rabies takes place so infrequently that this matter is of negligible importance.

The author then proceeds to discuss the problem as to what is the real nature of the rabies virus in view of its property of diffusing *in vitro* in certain liquids and organs. The absence of Negri bodies in the previously healthy brain which had become infective through contact with rabies brains goes against the view that the Negri bodies are of the nature of parasites. It appears more probable that they are the products of tissue reaction.

Moreover, if the spleens of animals dead of anthrax, tuberculosis, or glanders are suspended in glycerine the liquid may be subsequently inoculated without danger into a susceptible animal although the

glycerine acts as a preservative on the causal organisms of these diseases. The virus differs from chemical substances and solutions in that it will only traverse a comparatively coarse filter; also high power centrifugation exerts a just appreciable effect upon the distribution of the virus in the fluid. After further argument the author emits the opinion that the virus represents a transition form between the visible micro-organisms and the colloids, diastases or toxins, thus approaching in some degree BEIJERINCK's conception of a *contagium vivum fluidum*, invoked as the cause of the "mosaic" tobacco disease.

MISCELLANEOUS.

ARCHIBALD (R. G.). **A Mycosis of Turkeys.**—*Jl. Comp. Path. & Therap.*, 1918. Dec. Vol. 31. Pt. 4. pp. 257–260. With 4 text-figs.

In this short note the author gives a description of lesions found on the head of a turkey forwarded to him at the Wellcome Research Laboratories, Khartoum, from Nyasaland. It was stated by the owner of the bird that many of his young turkeys had suffered from a disease in which lumps appeared on their heads and neck and occasionally on their knee-joints. The disease apparently had a predilection for young birds, usually attacking those between seven days and six months old, with a case mortality of 75–85 per cent. Older birds, however, rarely acquired the disease. The owner further stated that the prophylactic measures employed, viz., isolation and disinfection of the bird coops had failed either to prevent or eradicate the disease and that the various disinfectants applied to the lesion had proved a therapeutic failure.

From the photograph and description of the lesions they appear to bear, as the author himself admits, a most striking similarity to those of epithelioma contagiosum avium, or fowl pox [see this *Bulletin*, this number, p. 31]. Sections of the necrosed areas or ulcers stained by Gram-Weigert's method showed dense masses of coccal bodies morphologically resembling the spores of a fungus. These were Gram positive, circular, and varied from ·7 to 1·2μ in diameter. The larger spores apparently had a double-edged contour enclosing a paler staining central area. In the more superficial parts of the lesions they were found in dense aggregations limited by a wall or capsule, such aggregations resembling ascospores. Fungal filaments were, however, never found. The condition was not considered to be one of fowl favus or "white comb."

MACALISTER (G. H. K.). *Kumri.* **Combined Diffuse Sclerosis and Central Poliomyelitis of Horses.**—*Memoirs Dept. Agric. India*, Vet. Series. 1917. June. Vol. 2. No. 8. pp. 207–261. With 6 plates.

In his introduction to this somewhat lengthy dissertation on *kumri* the author defines the condition as "a chronic incurable disease of horses, characterised by inco-ordination and loss of power in the hind limbs, but not attended with obvious visceral disturbances, wasting of muscles or trophic skin lesions. It occurs in India, Ceylon

and the Federated Malay States, while a similar disease is known in China; but in India its incidence is restricted to certain Provinces. Australian horses are far more susceptible to attack than country-breds although the disease is not unknown among the latter. Similar affections possibly of like aetiology occur among cattle and other animals."

After dealing briefly with the records of the earliest known authenticated cases of *kumri* the author devotes a short chapter to the main characteristics of a typical case, "as a consideration of the appearances presented has an important evidential value in determining the type of paralysis present and the probable nature of the underlying pathological lesion."

A lengthy discussion is then given of the various etiological theories stated to be held at the present day by various investigators and others interested in the disease and which may be classed under the four following headings:—"(1) filariasis, (2) vegetable poison, (3) specific micro-organism of unknown type, (4) unfavourable climatic conditions and general surroundings or factors producing general disturbance of health to which *kumri* is secondary." Under the heading filariasis the author analyses the evidence on which is based the commonly held theory that the disease is caused by ocular filariasis. This condition is set up by a worm, probably an incompletely developed form of *Filaria papillosa* Rudolphi, and the very frequent association of this parasite with *kumri* lends considerable *prima facie* support to the view that they are etiologically connected.

The suggestion that the disease may be due to vegetable poisoning was put forward on account of the fact that the symptoms in lathyrism, caused by the ingestion of certain Indian pulses, in man somewhat resemble those of *kumri* in horses, but the symptoms shown in that form of poisoning in horses, however, differ very considerably from those of *kumri*.

Although no investigators have succeeded in finding a specific organism in *kumri* the suggestion has frequently been made that some such factor is responsible for the disease and that workers should pursue definitely a line of research directed to the discovery of this agent. Comparison may be made with the human disease known as anterior poliomyelitis, which has been demonstrated to be due to a virus, but the courses of the two diseases show important differences.

The part played by climatic conditions, etc., is undetermined, although in so-called typical *kumri* districts there is a damp soil and damp atmosphere trying to both man and animals that are imperfectly acclimatised.

The material for the research work described in the paper was obtained from 23 cases of *kumri* from Assam, Bihar, and the Deccan. In 18 cases a complete investigation was possible. 12 animals were sent to Muktesar or Bareilly, kept under observation for varying periods, destroyed and examined. The six remaining cases, obtained during the course of a tour in Assam were killed and examined on the spot and the material obtained at the autopsy brought up to Muktesar for further scrutiny. The cases were fairly representative of the disease in all its stages; two of them were country breds, the rest Arabs or walers. Their ages ranged between 7 and 16. The

pathological characters of the series of cases are surveyed as a whole. The investigation at the time of publication is said to be far from complete, as the greater part of the histological work on the central nervous system was still unfinished.

Repeated microscopic and cultural investigations of the blood and the cerebro-spinal fluid, of the central nervous system, and other tissues and organs failed to show the presence of any micro-organisms, bacterial or protozoan. No inoculations were performed in these cases, but a previous series of experiments carried out by Colonel HOLMES gave uniformly negative results.

A heavy infestation of the intestinal tract with sclerostome worms was noted in some of these cases; five out of 34 cases had a history of ocular filariasis, and, as regards signs of filariasis elsewhere, out of 22 cases six showed calcareous nodules in the liver, and two of these also showed similar pulmonary lesions. Careful search was made for these parasites in the cerebro-spinal fluid and in the medulla, but with negative result. In one case worms were present in the aorta and in the pulmonary artery near the base of the heart.

In two cases only did examination of the blood show any evidence of anaemia. No case showed any marked leucocytosis. The maximum degree of eosinophilia was 5 per cent., the average being 2·5 per cent. The heart was normal in every case. In five cases only was the bone marrow inspected; one of these showed considerable normoblastic reaction, the whole of the bone being occupied by red marrow. In the majority of cases the liver showed no pathological change; six showed calcareous nodules of the type attributed to filarial infection. The stomach did not show any abnormal changes. In three the small intestine showed congestion with inflammatory changes in the mucosa and abundant muco-secretion. The large intestine showed worm lesions in almost every case. Two cases showed a sub-acute interstitial nephritis. Foci of calcification were seen in the lung in two cases. No morbid changes were found in the spleen.

Paraffin sections of various parts of the brain and spinal cord were obtained for histological examination and, as staining methods, the author adopted certain adaptations of Mann's modifications of the Pal-Weigert and the Marchi processes.

A brief description of the normal disposition of the various tracts in the white matter of the spinal cord is given. In the majority of cases there was no naked-eye change observable in connection with the brain or cord. Three of the brains, however showed a condition of chronic fibrinous lepto-meningitis over the mesial portions of the cerebral hemispheres. In one case there was evidence of a considerable degree of cerebral congestion. None of the brains showed any basal meningitis. None of the spinal cords showed any significant meningitis. In three cases, corresponding to the brains above referred to, the dura mater over the brachial swelling showed on its internal aspect a ground-glass appearance in contrast to the smooth shining appearance in other regions. Inspection of the cut surfaces of the cord in different regions showed, as a rule, little or nothing abnormal. In two cases the grey matter in the lumbar region showed marked disorganisation with appearances of haemorrhage and necrosis. Two other cases, which clinically had shown the most severe symptoms, showed slight congestion of the white matter particularly in the

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lateral columns in the lumbar region. In no case were any definite areas of softening to be seen, or any ecchymoses in the white matter of the cord; punctate haemorrhages were, however, seen in the grey matter in a number of cases. The histological changes, which appear to have been fairly striking and constant in character and involve a somewhat highly technical description, are enumerated briefly in the following quotation.

[It is not clear whether the author made a comparative study of the histological structure of the spinal cords of normal horses in order to demonstrate the specificity of the lesions described by him.—ED.]

"The characteristic lesion of *kumri* is thus seen to be a diffuse sclerosis involving no complete or even extensive obliteration of any individual tracts of the cord, affecting principally the propriospinal tracts and to a lesser extent the efferent fasciculi of the lateral column and the efferent posterior tracts. Certain definite lesions of the cell groups of the grey matter are also present, but it has been seen that degenerative changes in the fasciculi directly associated with these groups are less marked than in the other tracts of the white matter. It is hoped that a more extensive study of the histological changes will explain this and some of the other inconsistencies.

"The lesions above described, however, are sufficiently extensive to produce a definite impairment of the kinesodic functions of the white matter of the spinal medulla, and it is possible to bring them into rough corelation with the clinical manifestations characteristic of the disease."

Microscopical and chemical examinations of the cerebro-spinal fluid were made. The number of cells per cubic millimetre ranged from 40 to 120, but the average reading was between 50 and 60. Microscopic examination of the centrifuged sediment showed that the great majority of the cells were lymphocytes, only a very small number of polymorphonuclears being present. In no case were macrophages, indicative of haemorrhage, observed. The chemical examination of the fluid was carried out on the lines indicated by MOTT (1910). The average quantity of protein present was ·4 per cent. and this figure showed surprisingly little variation in different cases. In no case did the test for cholesterol give a positive result but a small quantity of choline was present in one of the samples examined. The presence of protein in excessive amount or of the above mentioned abnormal constituents of cerebro-spinal fluid is said to be indicative of nervous degeneration. Tested with Fehling's solution the fluid appeared to contain no reducing substance.

The author's investigations close with a series of serological tests comprising a number of complement fixation experiments, using worm extracts or extracts of liver containing filarial lesions as antigens. Positive results were obtained with the worm extracts, but it was difficult to obtain a horse not affected with sclerostomes to act as a normal control. The experiments with the liver extracts apparently gave no results.

The author concludes the paper with a detailed discussion of the foregoing results. His final conclusions are as follows:—

"(1) *Kumri* is a paraplegic disease of horses, associated with a diffuse sclerosis of the white matter of the spinal cord, affecting principally the propriospinal tracts and to a lesser extent the fibres of the lateral efferent and posterior afferent tracts.

"(2) No causal micro-organism has been isolated from cases of *kumri*.

"(3) Filariasis and *kumri* are often coincident, but this is to be regarded as a chance conjunction and not as implying a causal relationship. This applies also to other types of helminthiasis.

"(4) It is possible that *kumri* may be due to some type of vegetable poisoning or mould intoxication. In the present state of knowledge, this is no more than a speculation, which future research may establish or demolish.

"(5) The disease occurs most commonly in low-lying districts subject to inundation, and is favoured by warm moist climates. These conditions play some part in the production of *kumri*, either as a predisposing agency, or primarily as the direct *causus morbificans*. That it is the primary cause of the disease can only be established by the exclusion of all other possible causes.

"(6) The condition is incurable, but general treatment may possibly arrest the degenerative processes in those nerve-elements, where these changes have not reached the stage of complete disorganization.

"(7) Until the nature of the causal agent is known, no specific preventive measures can be suggested, but ordinary general hygienic precautions may be followed with advantage."

STADHOUDER (L.). **Myelitis Transversalis.** — *Nederl.-Ind. Blad. v. Diergeneeske Dierent.* 1918. Vol. 30. No. 5. pp. 463–477.

In 1916 the author observed among eleven riding horses an outbreak of disease suddenly occurring, in which the most marked symptom was paralysis of the hind quarters. The disease, it is stated, was similar to that described by SOHNS in Java in 1917 and diagnosed as infectious anaemia [see this *Bulletin*, Vol. 5, No. 4, p. 257]. The author provisionally gave it the name of "X" disease. It was ascribed by another veterinarian to sclerostomiasis, but, although sclerostome worms might predispose towards the disease they could on no account be held to be the actual cause.

The symptoms to commence with were somewhat indefinite and were generally manifested as inco-ordination or stiffness of the hind quarters. This stiffness was much more pronounced on some days than on others. In some horses the paralysis seemed to affect more especially the suprascapular nerve while in others facial paralysis was marked. On further examination the diagnosis of this disease resolved itself into either paralytic haemoglobinaemia (equine haemoglobinuria) or myelitis transversalis. The author summarises the descriptions given of these two diseases as they occur in other countries and then gives with a little detail the clinical symptoms and lesions observed by him in the cases brought to his notice. His conclusions are somewhat as follows:—

1. The so-called "X2" disease is identical with that described in India, originally by HAYES, under the name Kumree.

2. HAYES's differentiation between congestion of the spinal cord and Kumree is applicable in the case of this disease and what appeared to be paralytic haemoglobinaemia corresponded with congestion of the spinal cord as described by him.

3. The possibility that the purely nervous disease described as Kumree by HAYES is identical with that occurring in Java and now called Myelitis transversalis is increased by the fact that HAYES stated that the affection was often to be observed in tropical marshy districts.

4. It is not impossible that incomplete recovery from paralytic haemoglobinaemia may develop into myelitis transversalis.

The disease may thus be ascribed to (a) myelitis as the result of the parasites or toxins, (b) paralytic haemoglobinaemia due to toxins, with accompanying myelitis, (c) overstrain, causing paralytic haemoglobinaemia resulting subsequently in death or bilateral lameness.

[The author's statements are apparently to be taken with reserve inasmuch as his theories seem to be based entirely on clinical evidence and not on experimental work.—ED.]

REPORTS.

BEVAN (Ll. E. W.). **Extracts from the Report of the Veterinary Bacteriologist for the year 1917.**—*Rhodesia Agric. Jl.*, 1918. Dec. Vol. 15. No. 6. pp. 506–509.

In addition to the routine work of the laboratory a certain amount of experimental research work was carried out in connection with horse sickness, contagious abortion, and the inoculation of cattle against tick-borne diseases.

Horse-sickness.—In his preceding annual report Bevan stated that 156 horses belonging to the British South Africa Police had been inoculated against horse-sickness and that although these animals were treated without regard to age or condition the mortality had not exceeded 12·82 per cent. The surviving 136 horses were distributed to the various Police Depots, were used for patrol work throughout the country and submitted to far greater risks of infection than had hitherto been possible. 26 animals subsequently suffered from re-infection but of these only six succumbed and it is doubtful whether all of them were actually the victims of horse-sickness. This result was considered so satisfactory that the Commandant General felt justified in submitting to inoculation all remounts purchased during the year. The usefulness and stamina of the horses did not appear to suffer adversely as the result of the inoculation. The inoculation of Police horses was carried out at a very small financial outlay and was undertaken in the first place in order to facilitate experiments, but the results inspired sufficient confidence to continue the work on a wholesale basis. In the course of this work attention was drawn to several phenomena associated with the disease; among others certain observations were made with regard to the influence of the serum of an immune animal upon the virus-vaccine and a line of research was suggested which has since proved of great value in eliminating some of the difficulties previously associated with the collection and storage of the virus-vaccine. It is stated that this method avoids all risk of haemolysis and that in over 200 horses treated no animal since distribution has revealed symptoms of pernicious anaemia, staggers, hepatitis, or any of those complications which have necessitated the withdrawal of other systems elsewhere.

Interesting results were obtained in connection with the inoculation against horse-sickness of foals, of which 15 were placed by their owners for experimental treatment during the year 1916-1917. Although it had been stated that foals possess no greater degree of immunity than older animals this was found to be incorrect. In all probability previous experiments had been conducted with a full-strength virus which was of sufficient strength to kill young and old alike, but when an attenuated virus was used, sufficiently strong to kill 12·82 per cent. of Police horses, it was found that foals yielded no reaction; those just weaned and up to the age of a year only occasionally showed a slight elevation of temperature; older animals up to two years in some instances suffered from a more marked thermal reaction. These observations co-incide with the practical experience of certain horse breeders.

Contagious abortion.—By means of the agglutination test the disease has been detected in Marandellas, Lomagundi, Bindura, Mazunga, Salisbury, and Gatooma districts, and it is feared that it is much more prevalent than at first suspected. Large quantities of vaccine made from the dead organism have been issued and from reports received it would appear to have played an important part in the elimination of the disease, but precise information from field officers is not available.

Plasmoses of cattle.—During the early part of the year 13 animals imported from Great Britain were inoculated and owing to unfavourable weather and the unsatisfactory nature of the stabling the results obtained were less satisfactory than usual, two Hereford bulls dying during treatment. In future it is proposed to inoculate imported bulls for the public provided they do not exceed 15 months of age and are not too soft or pampered or too finely bred.

"Until the practice of short-interval dipping becomes universal, that is to say, so long as areas remain from which ticks have not been eradicated the necessity for a safe and reliable system of inoculation against tick-borne diseases must exist: first, for the inoculation of cattle imported from tick-free countries for the improvement of our local stock; secondly, for the rendering immune of animals bred on tick-free farms to be distributed to infected areas; and, thirdly, for the protection of young stock borne on infected farms. The system of inoculation at present in use, although far from ideal, is fairly satisfactory, and as far as the three requirements above enumerated are concerned, may be regarded as a 'commercial risk.'"

BRITISH EAST AFRICA. **Department of Agriculture. Annual Report of the Veterinary Department for the year ending 31st March 1918.** [1917?] [STORDY, R. J., Chief Veterinary Officer.] pp. 87–94. 1918. Nairobi: Govt. Printer.

Diseases of Cattle.—East Coast Fever. Owing to the spread of this disease on the Uasin Gishu Plateau and the absence of many of the settlers on active service it became necessary to modify the quarantine regulations in that district. Over 100 dipping tanks are now reported to be in use in the Protectorate but their further construction appears to have been in abeyance during the year. Considerable losses have occurred among cattle drawn from the Kitui district as the animals have to pass through the heavily infected area of Machakos on their way to Nairobi. The importance of maintaining dipping fluids at proper strength is emphasised. The number of samples analysed during the year was 984. The results of the analyses were as

follows :—within 10 per cent. of correct strength 58·8 per cent., from 11 to 20 per cent. above or below strength 22·3 per cent., more than 20 per cent. above or below strength 18·9 per cent.

The quarantine on the Thika district established in 1915 owing to the occurrence of trypanosomiasis has now been confined to two farms. The measures adopted in dealing with the outbreak consisted in quarantine of all infected farms, periodic examinations of the blood of all cattle in the area, slaughter of all infected animals, and payment of compensation to owners. The number of animals found to be infected and destroyed was 249. The trypanosomes found were of the *vivax* and *dimorphon* types and the tsetse flies caught were *Glossina brevipalpis, G. longipennis,* and *G. pallidipes.* Only one specimen of each was found in 1½ years. Although in most cases the infection was most probably conveyed through the medium of tsetse flies cases were, however, found on a few farms in which no tsetse occurred ; Stomoxys may have been the transmitting agents in these cases.

Only a few cases of anthrax came under notice during the year.

Pleuro-pneumonia spread considerably in the Masai Reserve and two outbreaks occurred on the farms of Europeans. Veterinary surveys have been carried out in this area with a view to ascertaining the extent of disease and when this is completed it is proposed to form quarantine camps and carry out inoculations. Measures have been taken to prevent the further spread of the disease from the Reserve by prohibiting the movement of cattle out of it.

Contagious abortion appears to be widespread in most of the native reserves of the Protectorate and has been known to the natives for generations past.

Rinderpest occurred in 13 outbreaks and when sufficient staff was available the disease was suppressed by the double inoculation method. In the case of one outbreak there was abundant evidence to show that it was due to game, such as buffalo, eland, reed buck, and bush buck, as numbers of these were found dead from the disease. The number of deaths directly due to the double inoculation was established at ¾ per cent., and 2 per cent. of the animals aborted.

Outbreaks of blackquarter were reported in four districts and also in three native reserves.

Diseases of Equines.—Several cases of epizootic lymphangitis occurred in and around Nairobi and one case at Fort Hall. Treatment with potassium iodide proved successful in many cases but owing to the increased cost of this drug the treatment could not be carried out in many cases for a sufficient length of time to ensure a cure. Many cases of ulcerative lymphangitis were reported during the year. As the causal organism is ubiquitous the disease had been deleted from the list of compulsory notifiable diseases but later, inasmuch as many infected animals were found at work with discharging sores all over their bodies, it was decided to make the disease notifiable once more. No cases of glanders occurred during the year. Horse-sickness, however, was particularly rampant and districts hitherto known to be free from the disease were visited by this epizootic.

The principal sheep and goat diseases which came under notice were sheep and goat scab, Nairobi sheep disease, contagious foot rot, verminous gastro-enteritis, and contagious pleuro-pneumonia of the goat.

An outbreak of suspected East African swine fever was reported near Nairobi. A few statistics are appended with regard to live stock importations, meat inspection, trade stock, the Fort Ternan quarantine Boma, brands and the permit system.

The Annual Report of the Veterinary Bacteriologist for British East Africa for the same year (pp. 95–100) does not contain anything of striking importance. Statistics are given with regard to the results of examinations of specimens and slides received for diagnosis, the manufacture of rinderpest anti-serum and blackquarter, colon-bacillosis, and ulcerative lymphangitis vaccines.

FALKLAND ISLANDS. **Annual Report of the Chief Inspector of Stock** [ATKINS (W.)] **for the Year 1917-1918.** 3 pp. f'cap. 1918. Stanley: Stock Dept. [Report to Colonial Office.]

This report, dealing chiefly with statistics, contains very little mention of disease, from which the Islands appear to be comparatively free. Certain flocks of sheep appear to be infected with lice, and ophthalmia is said to be still prevalent among some flocks, but it is becoming less frequent each season.

NORTH WESTERN FRONTIER PROVINCE, INDIA. **Report of the Civil Veterinary Department** [QUIRKE T. F., Superintendent] **for the Year 1917-1918.** 10 pp. f'cap. With 14 tables. 1918. Peshawar: Punjab Frontier Press.

During the year under report the Staff of this Department was considerably under strength owing to the absence of members on military duty. The number of deaths from contagious diseases, however, unfortunately proved to be very high, viz., 2,904, as compared with 1,827 in the previous year.

Among horses contagious diseases were reported from all the districts. In all 314 cases were reported, of which 85 died. The most serious disease was surra, 99 cases reported, of which 80 died. The most serious outbreak of this disease occurred at the Thal-Parachinar tonga line and a number of cases also occurred in the villages of the Kurram Agency. The measures taken, however, to confine the disease were completely successful. Five cases of glanders were detected. Inspections of mares were carried out at all the fairs for the detection of dourine but no case was discovered.

In cattle the chief contagious diseases as usual were foot-and-mouth disease, rinderpest, and haemorrhagic septicaemia. Foot-and-mouth disease was unusually rife owing to the abnormal rainfall during the year. Rinderpest appeared in four districts and one Agency; 1,825 cases were reported of which 928 died. There was a large increase in preventive inoculation against this disease, viz., 9,190 in 33 outbreaks; three animals died after inoculation and 830 uninoculated animals died in the course of these outbreaks.

Haemorrhagic septicaemia was reported from all the districts and two Agencies; in all, 902 cases were reported, of which 725 died. 3,851 animals were inoculated with serum against this disease in 14 outbreaks, and 7,219 were vaccinated in 20 villages where the disease usually appeared. Although the rainfall during the year was abnormally high it is satisfactory to note that in the 20 villages where vaccination

work was carried out no outbreak of the disease occurred although it was prevalent in the surrounding areas. There were 17,001 cases of foot-and-mouth disease reported, of which 61 died. Blackquarter was reported from two districts and one Agency; 74 cases occurred of which 61 proved fatal. A few cases of contagious pleuro-pneumonia, gillar, mange, vil, ringworm, and cow-pox also occurred.

A detailed account of the horse and cattle breeding operations is given. Regarding horse-breeding operations it is stated that the Province should be more self-contained in this respect and less dependent on outside Provinces for its requirements.

MADRAS PRESIDENCY. **Annual Administration Report of the Civil Veterinary Department for 1917-1918.** [WARE, F., Superintendent.] 25 pp. f'cap. With 1 map. 1918. Madras: Supt. Govt. Ptg.

70,018 cattle were reported to have died from contagious disease, as compared with 68,588 in 1916–1917. The increase was due entirely to the ravages of rinderpest, there being a fall under every other head as compared with the preceding year. In horses glanders and surra were much more prevalent than they have ever been reported to be before.

Rinderpest has increased in severity in the Presidency during each of the last five years until the large figure of 30,733 reported deaths was reached during the year under report. In the course of 600 of the outbreaks attended to 97,516 animals were inoculated against the disease. The districts where the disease caused most trouble during the year were Anantapur, North and South Arcot, South Kanara, Malabar, and Chingleput. It was proved beyond doubt that the primary infection in each of the frontier districts mentioned came from Mysore and was carried into the Presidency by cattle either returning from grazing as in the Anantapur district or brought for sale to some of the numerous cattle fairs held in the Presidency. In the case of each outbreak it is now suggested to close cattle fairs and markets temporarily in the district involved, but this advice is not always taken. It is hoped that when the present widespread epizootic has passed away a more or less immune generation of cattle will be left and that it will be some time before the same trouble is met with again. SHILSTON, Second Bacteriologist, Muktesar Laboratory, who toured the Presidency in connection with rinderpest in January 1917, recommended the simultaneous method of inoculation, but this method has not been adopted to any considerable extent up to the present on account of the shortness of staff. After an extended trial in the Presidency it has to be admitted that the "serum alone" method of inoculation will not stamp out rinderpest in the country while the conditions under which it has to be used in the villages remain as they are. Nothing less than compulsory inoculation will give the serum a fair chance, for in a typical village rarely as many as two thirds of the cattle are produced for inoculation, and eventually the natives lose faith in the serum inasmuch as the inoculated cattle contract the disease from some uninoculated ones and perhaps die. The natives absolutely refuse to allow the nostrils of inoculated animals to be smeared with infective discharges.

7,962 deaths from haemorrhagic septicaemia occurred as compared with 8,635 in the preceding year. 12,807 inoculations were performed against the disease. The greatest mortality occurred in the Guntūr district. Inoculation against this disease appears to be more popular among the natives than in the case of rinderpest.

7,691 deaths occurred from anthrax as compared with 7,900 in the preceding year; the districts reporting the greatest mortality were Malabar and Kistna.

Blackquarter produced a reported mortality of 5,483, as compared with 6,927 in 1916–1917. 433 vaccinations were performed against the disease.

2,068 deaths were reported from foot-and-mouth disease as compared with 2,637 in the previous year.

No cases of dourine were reported.

Some remarks are next added with regard to glanders, surra, kumree, piroplasmoses, rabies, sheep pox, and pleuro-pneumonia of goats. The Glanders and Farcy Act has now been extended to the whole Presidency in respect of surra and this has enabled the Department to take measures to prevent the spread of the disease, but it may shortly be found that it is useless notifying only equines for surra under this Act as evidence is accumulating to show that actual epizootics of surra occur amongst bovines occasionally in the Presidency.

Further notes on miscellaneous work are added, together with the Annual Report of the Madras Veterinary College for 1917–1918.

NYASALAND PROTECTORATE. **Annual Report Dept. Agric. for the year ended 31st March 1918. Veterinary Division. Report of the Acting Senior Veterinary Officer** [DE MEZA, J.]. pp. 18–19, f'cap. Zomba: Govt. Ptr.

Owing to the threatened invasion of rinderpest from the North the greater part of the staff was on duty out of Nyasaland. Arrangements were made to supply the Nyasaland Field Force with meat and for this purpose large numbers of cattle had to be brought from country districts through dangerous tsetse belts. Routes had to be mapped out so as to avoid infection as much as possible.

Demodectic mange in cattle has now almost disappeared in the Zomba district. The rigorous methods employed for combating this disease during the last few years are now giving beneficial results, for, whereas Nyasaland has practically rid itself of the disease, the neighbouring territories are experiencing considerable trouble from it.

Bovine redwater appeared on one plantation in the Mlanga district and several animals succumbed to it. Following upon treatment with trypanblue, however, no further deaths occurred.

Several isolated outbreaks of trypanosomiasis occurred during the year. One outbreak occurred at Mlanga; owing to the presence of *G. brevipalpis* in this district it is feared that cases of the disease will occur from time to time. At the end of last year the Protectorate was threatened with an invasion of rinderpest. A Commission under the direction of Lt.-Col. GRAY [see this *Bulletin*, Vol. 6, No. 2, p. 115] commenced operations on the 7th May and inoculated a large number

of cattle by the simultaneous method. The cattle in the North Nyasa district were moved south of the Stevenson Road and a cattle-free zone of between 20 and 30 miles was thus formed. The Commission was successful in its main object, viz., in preventing the spread of the disease southwards.

An account of distomiasis in cattle is then given. The ordinary intermediate host of the fluke found in other countries—*Limnaea truncatula*—has not yet been discovered in Nyasaland.

Ophthalmia again gave rise to considerable trouble in cattle during the dry season. Profiting from past experience cattle owners now start treatment immediately the first symptoms appear and very little serious damage is thus said to be caused. The author believes that this disease is not infectious but caused by irritation from foreign matter, such as grass seeds getting into the eye. A solution of zinc sulphate is said to be efficacious for washing the affected eyes. A few cases of so-called "three-day sickness" occurred but the number was fewer than in preceding years. There was no case of rabies. There was a large mortality in poultry from fowl cholera. There were a large number of cases of tick fever in dogs, but treatment by inoculation with trypanblue was successful in the majority of cases.

TRINIDAD & TOBAGO. **Report of the Government Veterinary Surgeon for the Year 1917.** [MILLER J. Duncan.] 4 pp. f'cap. 1918. Port of Spain: Govt. Ptg. Office.

This report first deals with the inspection of imported stock into the Colony. With the exception of "anthrax disease of Venezuelian cattle" and strangles among American mules there were no other contagious diseases among imported stock during the year. As regards the diseases of stock in the Colony these are caused mostly by "nematode and filarial parasites." Sporadic cases of anthrax have occurred in different places in the Colony but in each instance with the immediate action taken for the protection of any in-contact stock by means of a single anthrax vaccine, there was no other case. Deaths from anthrax were found up to 10 days after inoculation, but after that period no further deaths occurred. In infected estates where vaccination is regularly carried out every six months no cases have occurred and no ill-effects have followed this repeated vaccination.

"Granular dermic sores" were found on the legs of 20 per cent. of the donkeys in the Naparima district of the Colony. The sores were caused by the bites of flies infected with a nematode worm setting up on the fore limbs, especially at the knee and fetlock joint, pruritic patches on the skin at first, but spreading with renewed infections and neglect so as to form enlarged granular formations containing calcified parasites; sometimes the inner canthus of the eye and hind limbs were affected. The donkeys belonged mostly to East Indians and were kept in an insanitary condition. In the earlier stages it was found sufficient to treat the sores with tinct. iodi fort., sprinkle with a desiccating powder, and then apply bandages. The pest of flies, mostly the domestic fly and Stomoxys, in the Colony, especially in the Napiramas, has been extensive during the year, and may be due to the gradual destruction of birds and insect-eating animals by the mongoose.

A severe drought was experienced in the Colony during the early part of the year and during this time animals were affected with nematode infestations. When the animals were kept in good condition they resisted the attacks of these parasites but many were in an impoverished condition and died affected with strongyles. Early fumigations of five minutes duration with sulphur at three day intervals for two weeks cured some cases; others required further treatment with vermifuges such as lysol, arsenic, and sulphate of copper.

The Colony continues to be free from hydrophobia.

YOUNGBERG (Stanton). **Résumé of the Work of the Veterinary Division for the year 1917.**—*Philippine Agric. Rev.*, 1918. Second Quarter. Vol. 11. No. 2. pp. 83–95. With 1 plate.

The bulk of this report deals with the measures undertaken for combating a severe outbreak of rinderpest in the Philippine Islands: this had assumed serious proportions in 1916 and continued with unabated virulence throughout the year 1917, causing during the year 33,971 reported cases and 26,951 deaths, and involving thirty provinces. Increased funds were allotted in order to deal with this epizootic. A number of provinces were visited with the disease which had not been infected for several years with the result that the animals in them were highly susceptible. It was not always possible to trace the source of the new infections. This can be readily understood when one takes into consideration the fact that not only carabaos and cattle, but also swine, sheep, and goats are susceptible to rinderpest and that these latter animals often have the disease in a mild obscure form. It is suggested that infection was spread among the Southern Islands by means of small sailing vessels frequently carrying a few pigs or goats aboard. The disease now appears to have been brought under control in the newly infected provinces.

Considerable quantities of anti-rinderpest serum were used in the various provinces, especially those in which the disease had been recently introduced and was causing a heavy mortality. These were the places where the best results were expected from the serum and where in reality the least satisfactory ones were obtained. This was accounted for by the fact that as there had been no severe outbreaks of rinderpest in many of these places for several years a considerable number of susceptible animals had been produced in the meantime; also the disease during the present outbreak was of a very virulent type. A considerable degree of laxity was displayed in carrying out measures of quarantine and isolation in the case of animals injected with serum. The majority of people unfortunately expected too much from the serum; many were of the opinion that the immunity conferred would last as long as a year. Experience, however, showed that the serum could not be depended upon to confer an immunity for a much longer period than ten days. Records were kept of animals which showed symptoms of rinderpest even within a week after the injection of serum. The opinions of various authorities are quoted in support of these statements. The method employed in India of mixing the animals inoculated with serum with

the sick ones to induce a mild infection could not generally be employed in the Philippine Islands, the reason being that the cattle and carabaos are more highly susceptible than those of India and therefore disastrous results might be obtained with this procedure. It is possible that fairly good results might be obtained with this method in the Ilocos province where the present rinderpest infection is very mild.

A considerable quantity of serum was purchased and a large quantity of this was distributed free of charge. Tests as to the efficacy of the serum as a cure coincided with the results previously obtained by several workers, viz., that serum has no curative value for infected animals. The continuance of the free issue of the serum or its sale at half price is not recommended for the reason that the results obtained from serum are not commensurate with the expense involved. The immunity conferred is too short to be of any value in the eradication of the disease. On the whole it is safe to say that in the provinces people who have had experience with anti-rinderpest serum do not now have the same faith in its efficacy as they possessed a year ago.

Most of the immunising operations during the year were carried on in the province of Pampanja inasmuch as immunisation of cattle and carabaos had been begun in that province in 1914 and was steadily continued during the year 1915–1916. The total number of animals immunised at different stations during the year was 7,191 and the total number of deaths occurring from all causes from the time of entrance until the release of the animals was 274 or 3·8 per cent. of the number admitted to the stations. Several of the deaths occurred from such causes as colic, tetanus, abortion, paralysis, and injuries accidentally received. But the most difficult problem was presented by the animals that were already in the period of incubation from rinderpest although apparently normal at the time of arrival at the station and then showed symptoms within about three days after arrival. It was possible to save but a small percentage of these animals. The retention of animals under observation for some days before submitting them to the simultaneous inoculation was tried in an endeavour to eliminate this factor, but this plan did not find favour with owners, who considered that the three weeks period required for immunisation a sufficiently heavy burden.

Of the imported animals received during the year at the Iloilo and Pandancan stations nearly every shipment was on arrival found to be infected with rinderpest; four lots of cattle imported from Hong Kong were found to be badly infected and considering that the voyage from Hong Kong to Manila lasts only 60 hours it is strange that no evidence of the disease was noted at embarkation. One shipment of cattle from India showed symptoms of foot-and-mouth disease three days after arrival. Two different consignments of carabaos from Cambodge (Indo-China) were also found on arrival to be affected with this disease.

During the past four years 30,131 carabaos and cattle have been immunised against rinderpest by the Bureau of Agriculture. These animals live in rinderpest-infected districts, are not submitted to quarantine regulations and have had ample opportunity to contract the disease, but it was ascertained that less than 1 per cent. of these animals subsequently contracted rinderpest. Experience seems to indicate that immunised sucking calves lose their immunity after a

year or thereabouts. This is not a serious defect as these animals can be returned to be immunised at the end of this period and still not cause the owner much inconvenience, as then they would not be old enough to work. Further experiments are being conducted to test the immunity conferred upon sucking calves by simultaneous inoculation. This will be reported upon in detail when more definite conclusions have been arrived at.

In conclusion it is recommended that "immunisation properly applied is the surest method for the control of rinderpest, and with judicious extension will be one of the prime factors in the eradication of rinderpest in a short time and without the necessity of observing the fundamental principles of sanitation and hygiene."

Further notes are added on foot-and-mouth disease, surra, glanders, hog cholera, anthrax, and haemorrhagic septicaemia.

Dealing with the work of the Veterinary Research Laboratory attention is called to a new form of pneumonia discovered in swine and alluded to in the Annual Report for 1916. During the past year additional work has been done on this disease. It has been found that the causal organism is a "pseudomomas." The symptoms are similar to those of the chronic form of swine plague and the lesions are also very similar to those of this disease. The organism is said to be easily cultivable on artificial media and is pathogenic to rabbits and guinea-pigs causing a severe septicaemia when injected subcutaneously, the animals succumbing in two to three days. A method for immunising against this disease is being worked out and so far favourable results have been obtained.